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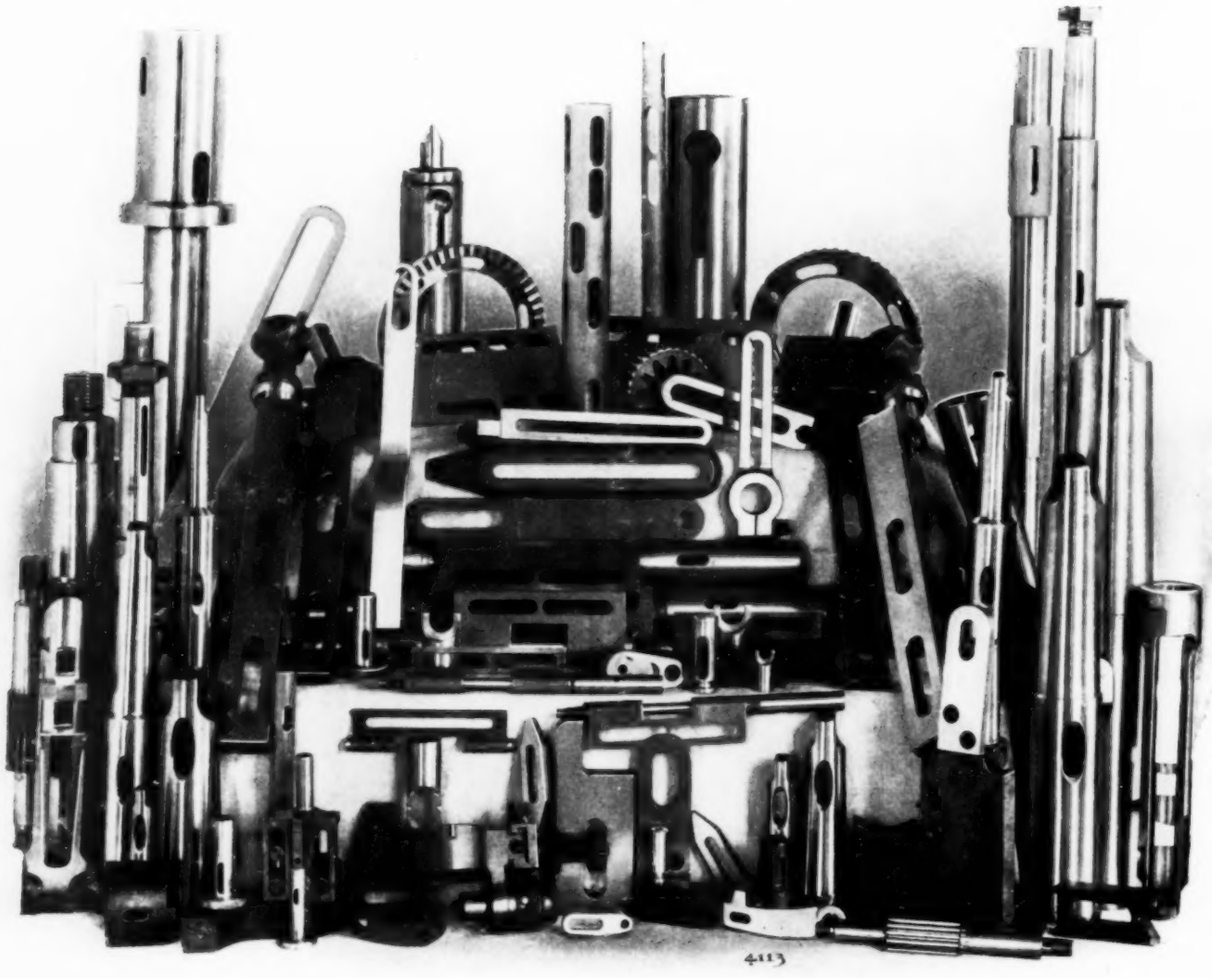

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A long needed machine for reducing the manufacturing cost of adjustable wrenches, drill sockets, key-ways in shafts and spindles and various parts of machine tools, small arms, automobiles, vending machines, etc., dependent on slots or a sliding action.

Invaluable in Small Arms Manufacture.

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The Making of Drop Forgings

By E. F. Lake

The different methods employed in making forgings and their quality as compared with other methods of shaping up steel. The grades of steel that are used in drop forgings and the effect that the forging temperature has upon these metals. The bending, forging and trimming, dies and straightening press used in drop forging crank shafts for automobile engines.

The kind of metal and methods employed in making forgings and trimming dies for gear blanks and various odd shaped pieces, as well as the necessity of having a roughing and finishing forging die for certain irregular shapes.

The bar of metal used for making drop forgings and the various stages or operations through which it passes before it becomes a finished forging.

The methods and rolls used for putting a long tapered point on steel bars.

When strength and durability are required in a machine part, and this part is of a size or shape that will permit, the forging process is generally used.

When a number of pieces can be made of one shape, it is, doubtless, the cheapest and best way to have dies made and form each piece in these dies, either from ordinary carbon or high-grade alloy steel, as may be desired, and in either a drop hammer or squeezing press.

The new welding processes that have been brought into commercial use have enabled more intricate-shaped pieces to be forged than could otherwise have been done, as the forgings can be made in two or three parts and then welded together.

These welds have nearly as high an efficiency as the original section of the metal. They are made either by electrically heating the parts and squeezing them together, or by melting new metal into the joints with blow torches that use various kinds of gases, an example of this being the oxy-acetylene welding process.

Dies

In the drop-forging process, the shape of the piece wanted is usually cut out of two blocks of 60-point carbon steel. These dies are usually parted on the center line, but the shape of the piece largely controls this.

The lower half of the die is fastened to the bed or anvil of a press, and the upper half is fastened to a ram that is connected to the piston in a steam cylinder. The piece of steel is heated to a good forging temperature, and the upper half of the die is then used as a hammer to strike the hot metal a series of blows and thus force it to fill both the upper and lower halves of the die.

The dies are always given considerable draft so the forging will easily free itself from the impression. To make the forging fill the die impressions, it is necessary to use a piece of metal of greater volume than the finished forging, and an opening from 1/8 to 1/4 inch is left between the upper and lower part of the die, so the surplus metal will be squeezed out and not break the die. This surplus is trimmed off in trimming dies.

Locating and Operating Dies

An important point in setting the dies is to locate them so both the upper and lower half will come exactly in line. While operating, a cloth, well soaked in oil, should be frequently rubbed in the upper die, to prevent the scale from sticking. In most cases this should be done every time a forging is made.

In the lower half of the die, an air blast that is strong enough to blow out the scale is the best thing to use. Steel-wire brushes can be used for this purpose, but the air is much quicker and more positive. This scale, if left in the dies, would work into the forgings and make them very hard to machine, as well as weaken the metal.

Size and Cost

With this process, the finished surfaces of forgings can be made to within 1/32 of an inch of their desired size on quite large pieces, and thus very little machine work is required. Some of the largest pieces that have so far been made by the drop-forging process are crank shafts for internal-combustion engines that weigh over 400 pounds, and the smallest that are made weigh less than 1 ounce. Thus there is a wide variety and range to the work that can be made in this way.

In arriving at the cost of forgings several factors have to be considered. These are: the number that can be made from one die; the number that can be made with one setting of the die; the quality of the steel used in the forgings, and the time, machinery and power used to manufacture them.

Grade of Steel

Any kind of carbon or alloyed steel can be made into drop forgings, if the proper temperature is maintained while hammering it into the dies. This requires, however, considerable skill and experience, on the part of the operators, if the best results are to be obtained. Steel containing over 1 per cent. of car-

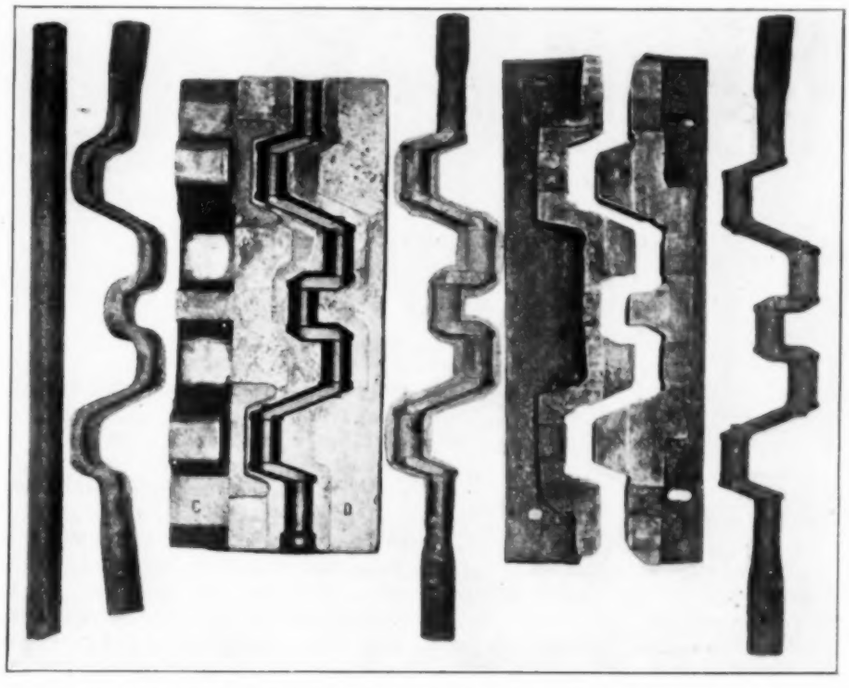


Fig. 1. Dies and Operations Used in Drop Forging a Crank Shaft

bon is very difficult to forge, owing to the comparatively low temperature to which it is possible to heat it without burning the metal, namely, about 1800 degrees Fahrenheit, and the comparatively high temperature at which the forging must be completed without danger

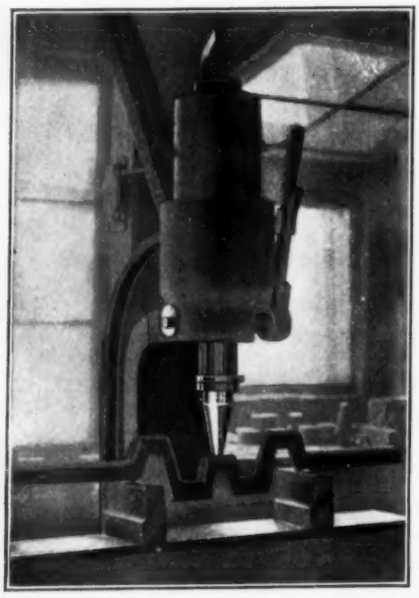


FIG. 2. PRESS FOR STRAIGHTENING CRANK SHAFTS AFTER FORGING

of cracking the piece, owing to its brittleness. During any of the forging operations, the metal should not fall much below its highest recalescent point which,

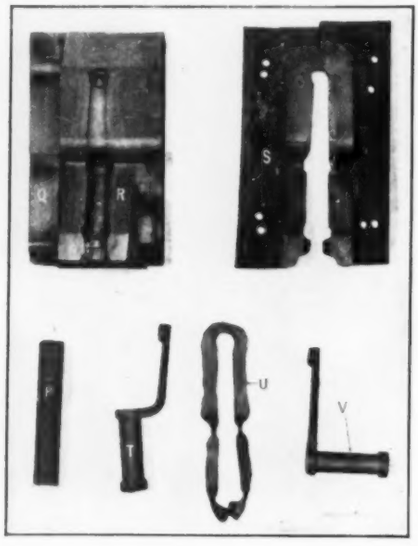


FIG. 4. FORGING AN AUTO STARTING CRANK

in a 1 per cent. carbon steel, is about 1650 degrees Fahrenheit.

This narrow range, i.e., between 1650 and 1800 degrees Fahrenheit, means that high-carbon steels must be heated several times while forging them, unless the forging is very simple in design. This is also the case with many of the alloyed steels.

Steels heated above the highest recalescent point assume a coarse-grained, crystalline structure that partially destroys the cohesive force that binds the molecules together. A weakened metal is thus the result. By hammering the metal into dies the crystallizing structure is broken up, if the blows are so regulated that the forging will be finished just as it reaches this recalescent point. Then a new grain structure is created that is much finer and the molecules are held

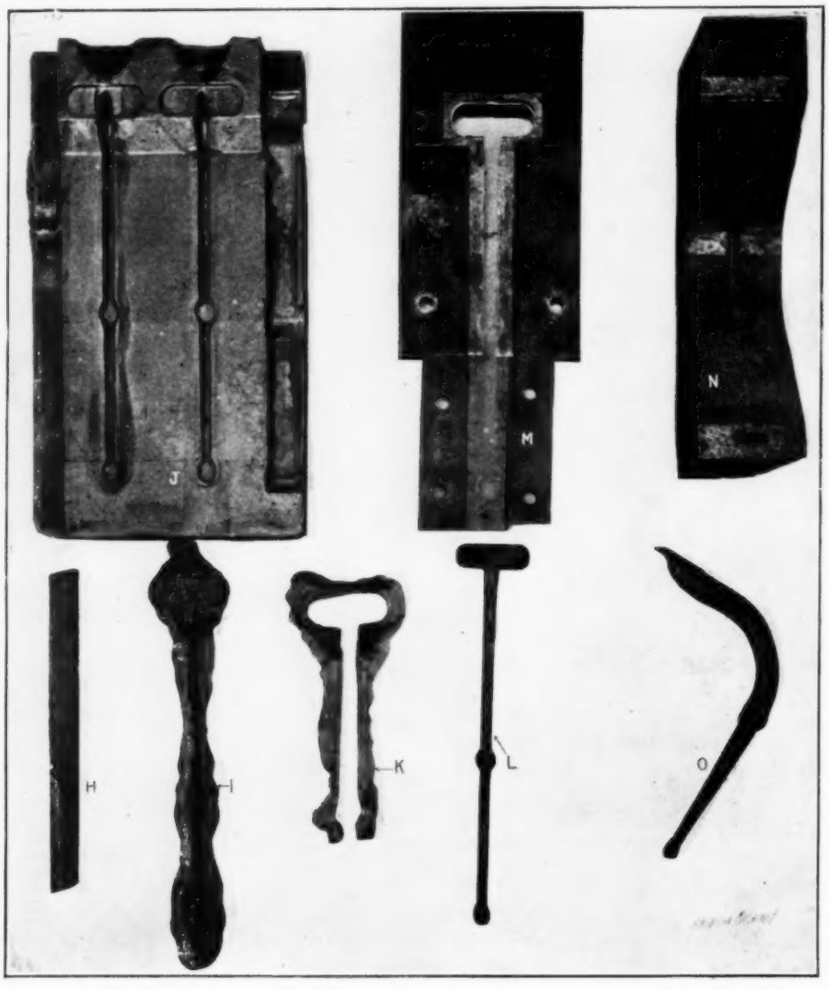


FIG. 3. FORGING AN AUTO RUNNING BOARD SUPPORT

together by a more powerful cohesive force. Any hammering after this point has been reached will set up strains in the metal that are liable to cause cracks and produce poor forgings.

Of the high-grade alloys, chrome or chrome-nickel steels are very difficult to forge, owing to their mineral hardness, but when titanium or vanadium has been added to either or both of these, the metal forges about as easy as ordinary carbon steels and forgings can thus be made of the strongest steels. Forgings can also be made that are stronger than rolled steel made under the best of conditions.

HEATING FOR FORGING

In heating steel for forgings, the temperature should be raised slowly to about 600 degrees Fahrenheit, and after that it can be raised as quickly as desired to the welding temperature. This is due to the fact that steel is not ductile below about 600 degrees Fahrenheit, and is not fitted to resist the strains imposed upon it by the differential expansion of an unevenly heated metal.

By heating suddenly, the outer shell becomes red before the core has had an opportunity to absorb any heat, and great strains are thus caused by the expansion of the outer shell. Due to these changes when heating up cold steels, and especially the high-grade alloys, many poor forgings are turned out by raising the temperature of the metals too suddenly.

Inferior forgings also may be made by the drop hammer only producing a bruising effect, by delivering a light blow that has comparatively no penetration, but a high speed. This causes spots of dense, fine-grained metal that has a great

strength, while around them are a coarser-grained and hence a weaker metal. This condition is impossible to alter by heat treatment of any kind, and thus the forgings cannot be made as strong as they should be, if too small a hammer is used.

Dies for Crank Shaft

The designing of the dies in which to make the forgings also requires considerable experience and knowledge as to the action of metals when heated. In Fig. 1 is shown a four-throw crank shaft for an internal-combustion engine that is being dropped forged by J. H. Williams & Co., of Brooklyn.

The forging dies usually have a bending form made in one side and separate dies have to be made for trimming off the flash or fin that is left on the forgings.

In Fig. 1 the straight round bar *A* is heated in the furnace and bent at the side of the die, shown at *C*, into the form shown at *B*. After bending, the piece is held over the lower half of die *D* and formed into the shape shown at *E*, by dropping the upper half of the die onto it. The flash on *E* is formed by the excess metal squeezing out of the opening left between the two halves of the die, which in this case was ¼ inch.

After this, the forging is pushed through the trimming dies shown at *F F*. This leaves the crank shaft as shown at *G*. It is then ready to be straightened and machined. The hydraulic press in which they are straightened is shown in Fig. 2.

Support for Running Board

The forging shown in Fig. 3 differs from the crank shaft, in that it is bent after being forged to shape. This forging is made out of a square bar, as shown at *H*. It is first roughed in the impression shown to the left of the die block *J*, after which it is finish forged in the right-hand impression, and this leaves it in the shape shown at *I*. It is then trimmed by pushing it through the trimming die *M*. This leaves the forging as shown at *L* and the flash or fin, which goes to the scrap pile, as shown at *K*. This is an automobile running-board support that, after forging to the shape shown at *L*, is bent in the shaping die *M* to the form shown at *O*. After drilling four holes in it, it is ready to use.

Starting Crank

One of the kinks in the forging business is well illustrated by the automobile starting crank that is shown with its dies in Fig. 4. The novice might think the simplest way would be to bend a bar to the form shown in *V* and forge it in that shape. This would mean, however, the cutting of a deep impression, in the die, for the part of the crank on which the handle goes, and also prevent its being made flat, owing to the draft that it would be necessary to give the die.

This piece is made from bar *P* by first placing it in the bending form *Q* on the left side of the die block and then drop forging it as shown at *R*. It then leaves the forging die in the shape shown at *T*.

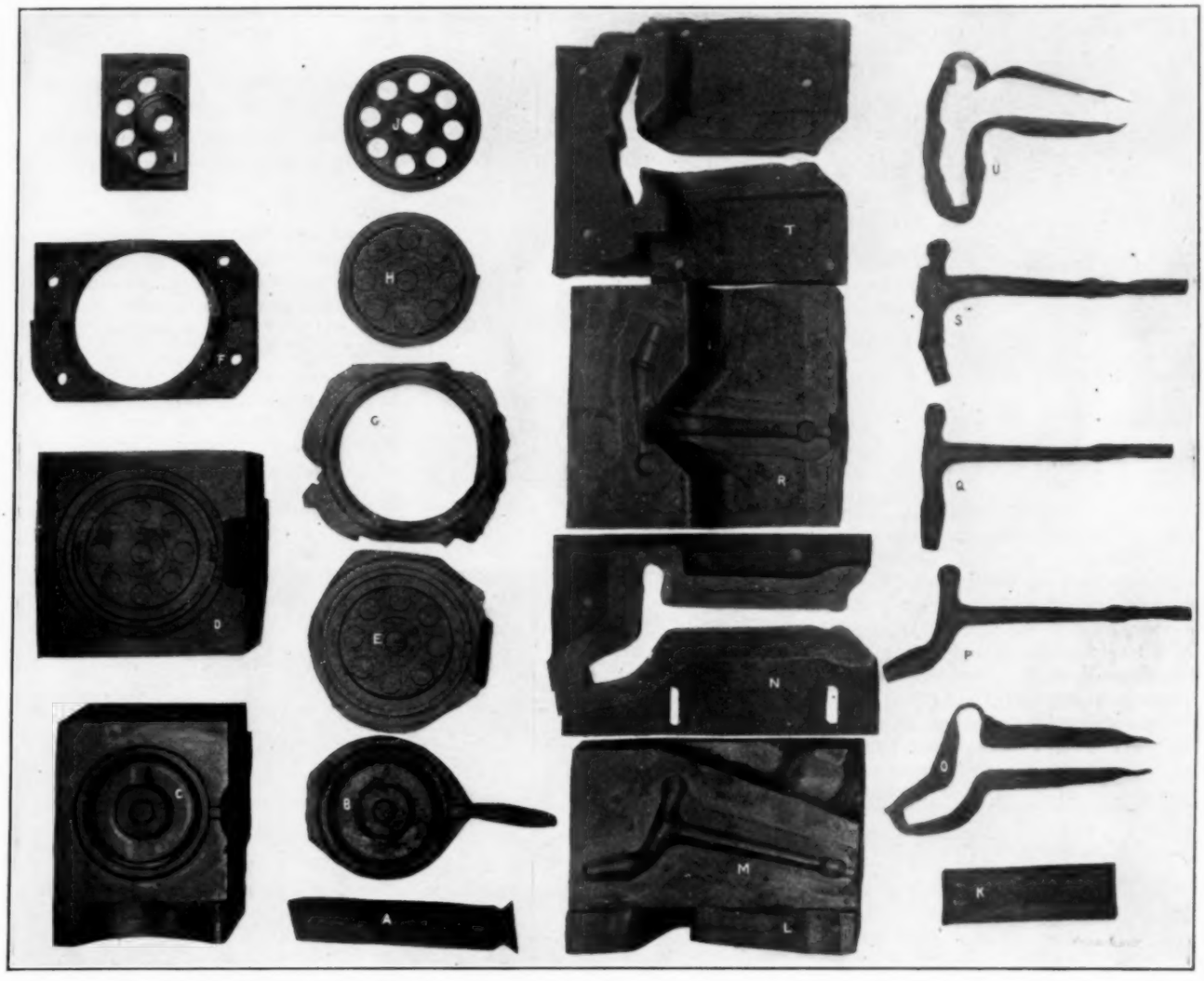


Fig. 5. Forging a Gear Blank

Fig. 6. Forging Auto Steering Knuckle Lever

After this it is trimmed in die *S*, which it leaves in the shape shown at *T*, with the flash or scrap metal as shown at *U*. The crank is then bent to the shape shown at *V*, which makes it ready to ship to the users for machining.

Gear Blank

Another interesting job is the forging of a gear blank, as shown in Fig. 5. The bar *A* is first rough forged to the shape shown at *B* in the die block *C*. It is then finish forged in die *D* and leaves it the shape shown at *E*. The flash is then trimmed off in the trimming die *F* and it leaves this die as shown at *G* and *H*. The holes in the center are then punched out in the die *I*, and the forging leaves it as shown at *J*, when it is ready to ship.

Steering-knuckle Lever

The forging of the automobile steering-knuckle lever, as shown in Fig. 6, presents features differing from all the others. It would be very difficult, if not impossible, to upset and bend a straight bar so it could be forged into the shape shown at *S*, in one operation. To make this job economically, it is necessary to have two sets of forging dies and two sets of trimming dies.

The bar *K* is first put into the edge *L* of the roughing die *M*, and bent to the form shown. It is then rough forged in die *M* and trimmed in the die *N*, and leaves this in the shape shown at *P*, with the flash shown at *O*. After this the rough forging is straightened as shown at *Q*, and forged in the finishing die *R*. It is then trimmed in trimming die *T* and leaves this ready for the machine shop in the form shown at *S*, with the scrap or flash as shown at *U*.

Auto Steering Knuckle

Still another method of forging a straight bar into a T-shaped piece is shown in Fig. 7. Bar *A* is first bent to shape in the side of the die at *B*, after which it is forged in the die at *C* and trimmed in the trimming die *E*. This it leaves in the shape shown at *E*, with the trimmed flash at *F*. The arms, that are then curved toward each other, are straightened out, as shown by the forging at *G*. After this the finishing forging is given it in the die *H*. It is then trimmed in die *I* and leaves it in the form shown at *J*, which is ready for the machine shop. The flash or scrap after this trimming is shown at *K*.

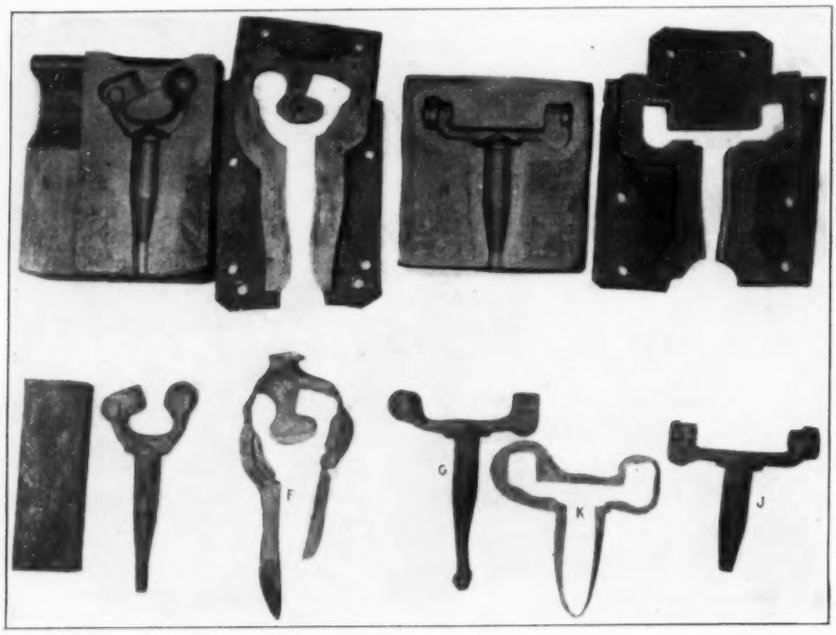


Fig. 7. Drop Forging an Auto Steering Knuckle

The method that this same company uses for pointing bars so that a wooden handle can be used on them is shown in Fig. 8. In this, the outsides of two rolls are turned so they will run eccentric and when they turn to the right place, the operator pushes the bar in as far as it will go, as shown. The rolls then catch it and bring it back toward him. In two or three passes the bar is rolled down to a sharp point. This method is certainly a simple one for tapering bars.

Heat Treatment After Forging Operations

Steel can be greatly improved after it is forged, by giving it the proper heat treatment. In fact, this is a very important factor if the greatest strength and the best wearing qualities are to be given the metal. The best of forgings can be very easily ruined by improperly heat treating them afterward, and thus care and skill used in making forgings would be of no avail.

Forgings also have a hard outer skin or scale when they leave the dies. This gives them a mineral hardness and makes them very hard to machine with any kind of cutting tools. To remove the scale small forgings are usually tumbled and the larger ones are pickled in a diluted solution of sulphuric acid.

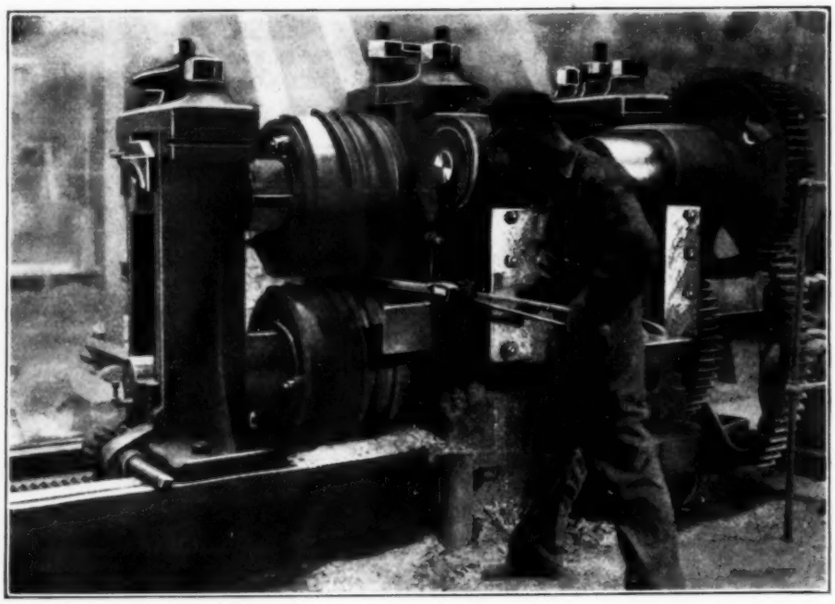


Fig. 8. Rolls for Pointing Long Bars for Wooden Handles

We are indebted to J. H. Williams & Co., Brooklyn, N. Y., for their coöperation in the matter of illustrations and information.

Influence of Impact on Gears

By Charles H. Logue

A suggested modification in the Barth equation as applied to the Lewis formula for the strength of gears which increases the speed with the spiral angle also giving the allowable increase in the load for generated teeth.

The Lewis' formula for the strength of gears originally read: $W = S p' f y$, a table being given in which the allowable stress of the material S was reduced as the speed of the gear was increased as shown in following table.

Later Carl G. Barth introduced an equation, $\frac{600}{600 + V}$, which gives practically the same result as the table when added to the formula; the value S being the safe working stress per square inch of the material used, or:

$$W = S p' f y \frac{600}{600 + V}.$$

Mr. Barth's equation is the one commonly accepted. It is evident, however, that this value will vary for different conditions, the design and workmanship being important factors in its proper determination.

Speed of teeth in feet per minute	100 or less	200	300	600	900	1200	1800	2,400
Cast iron	8,000	6,000	4,800	4,000	3,000	2,400	2,000	1,700
Steel	20,000	15,000	12,000	10,000	7,500	6,000	5,000	4,300

SAFE WORKING STRESSES IN POUNDS PER SQUARE INCH FOR DIFFERENT SPEEDS.

The load is reduced as the speed increases on account of impact. It is evident that an accurately spaced and generated gear should have a much higher value than one cut by ordinary methods.

It is also evident that helical and herringbone gears, owing to the nature of their tooth contact, should have a much higher value, as they operate under entirely different conditions, therefore are capable of heavier loads at higher speeds for the same area of tooth contact. Rawhide gears should also have a higher factor, as rawhide will absorb shocks that would affect harder materials.

In the absence of all vibration, and with an indeflectable material, this equation could be eliminated from the formula for strength and wear. These are conditions that can never be attained, but it is evident that this value will stand extended investigation.

Increasing the angle of the teeth in herringbone gears increases their smoothness of action; that is, there will be less vibration in a pair of such gears with a tooth angle of 45 degrees than one of 30 degrees. The quietest possible drive for parallel shafts is a friction gear as shown in Fig. 1, the movement of the driven gear depending upon lateral pressure applied to the pitch surfaces. The first step for a positive drive would be to compare the driver of two single-thread worms, as per Fig. 2. Such gears will operate without noise or vibration under conditions that would be prohibitive for gears having a spiral angle of 45 degrees, and gears of 45 degrees will operate where ordinary spur gears could not be used. The only drawback to the increased angle is increased wear, due to the reduced tooth contact, for, as the angle is increased the points of contact become sharper, although their number is increased. The face of helical or herringbone gears must therefore, be increased with the spiral angle for a given load.

For such gears I would suggest the following equation:

$$\frac{\rho}{\rho + V}$$

in which

$\rho = \frac{600}{Cos.^4 E}$;

V = Velocity in feet per minute;

E = Spiral angle.

Thus for a generated herringbone gear having a spiral angle of 30 degrees the Lewis formula would read:

$$W = S p' f y \frac{\rho}{\rho + V} = S p' f y \frac{1800}{1800 + V}$$

Referring to Fig. 1, it is readily seen that there is no necessity for restricting the load for such a pair of gears on account of impact as the speed is increased, as the engagement of the teeth is continued. Such a pair of gears, of course, must transmit its load by friction, which is maintained by lateral pressure. For this reason the ratio of the drive is not constant.

The first step toward a positive ratio drive is shown by Fig. 2. The driving member consists of a pair of single-thread worms, or one-tooth spiral gears, of right- and left-hand obliquity, engaging a worm with a number of threads, or teeth, according to the desired ratio. Both of these gears must have the same spiral angle and the same normal and circular pitch. This drive will transmit no more power without crushing the material than that illustrated in Fig. 1, but slipping is impossible. It is also evident that the reduction of the load on account of impact should be practically the same.

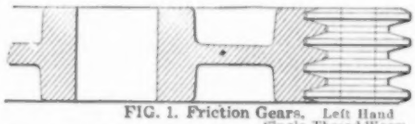


FIG. 1. Friction Gears.

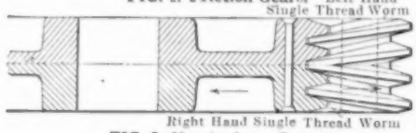


FIG. 2. Herringbone Gears.

American Machinist

Influence of Impact on the Strength of Gears

In the herringbone gears shown by Fig. 2, the problem is essentially one of wear, not of strength. This applies to all herringbone gears of sufficient angles to maintain continuous contact at the pitch point. The value of ρ used in the formula may also be used to determine the maximum speed when multiplied by the number of teeth in contact and the circular pitch p', as published in the AMERICAN MACHINIST, page 917, Vol. 32, Part I.

$$Safe\ Speed = p' n \rho$$

	Commercial Cut.	Generates.	
For 0 degrees ρ =	600	800	spur gear
For 10 degrees ρ =	700	1,000	herringbone
For 20 degrees ρ =	800	1,400	herringbone
For 30 degrees ρ =	1,100	1,800	herringbone
For 45 degrees ρ =	2,400	4,000	herringbone
For 60 degrees ρ =	9,600	14,000	herringbone
For 80 degrees ρ =	700,000	900,000	herringbone
For 90 degrees ρ =	infin.	infin.	See Fig. 1

In spur gears, the essential point is the shape of the teeth. Departure from the theoretical form results in instantaneous acceleration and retardation which necessarily increase the impact and therefore, the fiber stress. We must therefore lower the load with which the teeth may be trusted. This is not the case for herringbone gears, as the shape of the teeth, as regards impact, is of less importance if interference does not occur. In fact, the best results are obtainable when a shortened tooth is used. The curve being modified so that contact oc-

curs at the pitch line only, does away with all sliding friction. Herringbone gears so designed are designated by Professor McCord in his "Kinematics" as the very perfection of geared wheels.

There are many other things which will influence the equation for impact, foremost among them being the design of the gear. It is evident that the stresses in the teeth due to accelerations and retardation will be greatly increased when the rim is proportionately heavy or when the wheel is webbed or solid. The load on the teeth should not be sufficient to cause any deflection, as this will cause an irregular movement that cannot be overcome by careful spacing and forming of the teeth.

In and Around Frankfurt

Editorial Correspondence

The German shop of the United Shoe Machinery Company at Rodelheim.

The air compressors made by Poronky & Wittekind and an anti-rust compound that worked.

The Adlerwerke automobile and typewriter plant; the grinding machinery of Meyer & Schmidt and Friedrich Schmaltz.

One of the most modern shops in the vicinity of Frankfurt-a.-M., is the German plant of the United Shoe Machinery Company at Rödelheim. Here we were cordially welcomed by the works manager, Charles N. Powers, an American and shown a machine shop equipped with American tools.

The buildings are new, of brick, concrete and glass with an unusual amount of light area in the side walls. Careful provision has been made for growth, both in the arrangement and use of the land and design of the buildings. The power station is a detached building connected with the shops by an underground tunnel.

The arrangement of tools and departments is similar to American practice, as is natural under the circumstances. A pleasing feature of the entire plant is its neatness and cleanliness, far different from many plants that are seen. As American-designed machinery is built, the dimensions are in English units, and not metric, and it has been necessary to teach the workers to understand and use the English inch and its multiples and divisions.

Poronky & Wittekind

Not far distant is the large plant of Poronky & Wittekind, builders of air compressors and pneumatic tools. The shops are crowded with work, much of it of large size, and among it two 1400-horsepower and two 700 horsepower compressors for Johannesburg, South Africa. Three interesting types of machines were seen: The first, a 4000-horsepower, 12-stage rotary compressor, compressing to about 9 atmospheres. This is a recent development and is said to be very successful.

The second is a two-stage compressor having a single cylinder, a trunk piston with two diameters and an intercooler. It is made in several sizes.

The third is a low-pressure, condensing, four-stage compressor of 190 horsepower rating, designed to use exhaust steam from other apparatus.

Large low-pressure cylinders are lined with cast-iron liners, shrunk in, for which operation the cylinder is heated by gas jets within a large steel shell. One important feature of the design of parts for handling exhaust steam is the care with which connections, etc., are laid out to obviate expansion strains from the high temperatures.

A special department of this works is fitted up to manufacture pneumatic hammers. These are made on an interchangeable basis, to very close limits. To illustrate this fact several valves and cylinders were taken at random from stock and fitted together. Special tools are one of the features of this department.

Here the use of an anti-rust compound was noted, that left a hard clean surface, something like a lacquered surface, and therefore more agreeable to handle than if vaseline slushes or similar substances are used.

The Adlerwerke Shops

The third shop visited in Frankfurt-a.-M., was the Alderwerke vorm. Heinrich Kleyer A. C. Here are manufactured automobiles, bicycles and typewriters. This year's production is expected to be 2200 automobiles, pleasure cars and delivery wagons from 15 horsepower up; 35,000 bicycles and 14,000 typewriters. Some 3500 men are employed in all departments, and all parts of the automobiles and bicycles are made, including the bodies and wheels of the automobiles and wheels of the bicycles. Thus the woodworking departments are quite important.

One of the latest developments of this firm is an automobile fire engine being built for the city of Frankfurt. It has a 45-horsepower engine connected to a centrifugal pump having a suction and discharge outlet on each side. A hand-operated clutch at one side disconnects the pump from the transmission shaft.

Meyer & Schmidt

At Offenbach, some eight miles from Frankfurt, we visited two factories building grinding machinery and making grinding wheels.

In the works of Meyer & Schmidt we saw several large special grinding machines in process of setting up. One of these is a large face grinder having two opposed cup wheels, each made up of a series of segmental blocks.

One difference between German machine-tool building and American is said to lie in the quality of the iron; this is an oft-mentioned point that the average run of German cast iron is harder than the average run of machinery cast iron used in the States. It is, therefore, claimed that the wearing surfaces made from the harder iron have a longer life than those of softer iron.

Meyer & Schmidt have an extensive exhibition at Brussels, where are shown, among others, an automatic twist-drill grinder that revolves the drill, an automatic hob grinder, a horizontal automobile-cylinder grinder and a large special grinder for grinding the pins of locomotive driving axles and intended for repair work.

Friedrich Schmaltz

The second grinding machine plant visited was that of Friedrich Schmaltz m. G. b. H., at Offenbach.

Here we found at one end of one of the main floors an exhibition room containing several of the smaller machines built by the firm, belted up and ready for demonstration at a moment's notice. An automatic twist-drill grinder a band-saw grinder, a circular cold-saw grinder and a vertical automobile-cylinder grinder. This last machine is made with two spindles and two machines of this type are now being built for an American locomotive-building firm.

This firm also builds two large special grinders, one for crank pins of locomotive driving axles, the other for journal bearings of locomotive wheel sets. The first-mentioned machine has a heavy counterweighted head carrying the grinding wheel, and it was pointed out that the government inspectors required a heavy guard to be placed over this head, having a door in front closed by the operating lever, so that the grinding head could not be set in motion until the door was closed by movement of the lever.

The Friedrich Schmaltz firm also makes grinding wheels in great variety.

It is a pleasure to end these few notes by acknowledging the uniform courtesy with which we were received at all of these shops, and the kind attention with which we were shown through the works.

Oxy-Acetylene Welding Apparatus–II

By E. F. Lake

Acetylene obtained in two ways for welding purposes. The apparatus and tanks required for storing acetylene. The kinds of generators that are used, as well as the safety apparatus it is necessary to install on them, owing to the explodability of acetylene if not properly handled.

The oxygen that can be obtained in storage bottles and that can be produced on the premises from generators. The kind of apparatus that can be safely used for generating and storing the oxygen gas under pressure. The kind of compressors used and the necessity of lubricating them with nothing but soap. The impurities in the gas and the methods of cleansing it in scrubbers.

In the acetylene apparatus that is used for welding a generator has been almost universally adopted. In a few places, however, acetylene has been used from storage tanks similar to those used on automobiles for lighting purposes.

It is very dangerous to compress acetylene by any mechanical means to over 30 pounds per square inch. The tanks mentioned above, however, are filled with some such material as asbestos wool and this is saturated with acetone.

The acetone has the peculiar property of absorbing twenty-five times its own volume of acetylene for each atmospheric pressure. This makes it commercially practical to dissolve in acetone a hundred times its own volume of acetylene. The acetylene then exists under a pressure of 150 pounds to the square inch, or 10 atmospheres.

The spaces left by the asbestos wool form separate chambers, that contain the acetylene dissolved in the liquid acetone. These chambers being small, an explosion would only have a small effect, as the walls of the chambers would be sufficient to arrest the propagation of the flame. With the dissolved acetylene a special high-pressure reducing valve is necessary between the tank and the torch.

These tanks are very handy when one wants to carry the welding apparatus to the work. The gas is used off until it gets to a very low pressure, after which the tanks are recharged. They are only practical, however, in a few places owing to the fact that the gas costs from three to four times as much as that which is automatically generated from carbide of calcium as fast as it is used. Ordinarily, work can be taken to a room or bench, specially fitted up for welding purposes, and then the acetylene generator is much the better and cheaper way of obtaining gas for welding purposes.

Carbide-to-water Generators

In the generation of acetylene many different methods and processes were thoroughly tested, before it came into use for welding and was only used for lighting purposes. After several years thus spent in experimenting with and testing different methods, we have come to the conclusion, today, that the carbide-to-water type of generator is the best for welding purposes, and nearly all are of that design.

These, however, must be constructed properly if they are to be made safe, and when so constructed they are automatic in operation and give very little trouble. It is very essential that they be frequently cleaned of the deposit left by the calcium carbide and also that the water be often changed.

They have a sheet-metal tank that is kept about half full of water. Inside this tank, and using the water as a seal, is located another tank with the lower end out. The calcium carbide by an automatic device is then dropped into the water, a few lumps at a time. As soon as the carbide strikes the water a chemical action is started up that allows the acetylene to escape and bubble up through the water, while the residue, which is slack lime, settles to the bottom of the tank.

This acetylene bubbling up through the water fills the upper part of the inner tank and causes it to rise and fall, accordingly as the acetylene is generated or it is drawn off for use. By this raising and lowering of the inner tank, the dropping of the carbide into the water is automatically controlled.

Removing the Heat

During this chemical reaction a large amount of heat is generated. As acetylene is much more explosive and dangerous at a high temperature, it is necessary to have the volume of water large enough to remove all of this heat. As six pounds of water can be made to boil by placing in it one pound of carbide, it will be seen how important it is to have a large volume of water. This should be not less than one gallon of water for each pound of the generator's carbide capacity.

Finely ground calcium carbide is not suitable for these generators. The lump carbide should be used, as the lumps fall to the bottom of the water before generating much gas and hence the gas travels up through the entire body of the water. This cools the gas and also removes a large part of the impurities that might be present.

In determining charges the ordinary lump carbide usually produces 4½ cubic feet of gas to the pound. The commercial ¼-inch carbide produced 4 cubic feet of gas to the pound, and the intermediate sizes are in proportion. The rating of generators may correctly be placed at 1 cubic foot of gas per hour, per pound of carbide. In the generators, however, that drop the water upon the carbide, high temperatures are produced, and the rating is less than one-half of this.

Important Details of Design

In constructing these generators arrangement must be made for the removal of the residue or slack lime while operating them. This settles to the bottom of the tank, and should be cleaned out every day.

Arrangements must also be made for keeping the water in the tank at a permanent level and giving it enough circulation to always keep the gas cool. The water should be removed every day and fresh water put in the tank in order to remove any particles of lime or impurities that it may hold in suspension from the gas bubbling up through it.

Acetylene generators should be provided with relief or blow off cocks so that the maximum pressure will not be exceeded.

Air ought to be strictly excluded from the acetylene chambers, as when this is present in the proper proportions, an explosive mixture is the result, and the apparatus becomes very dangerous. Air also weakens the gas and good welding cannot be performed when much of it is present in the acetylene.

No light, and especially no open flame, should ever be taken near an acetylene generator as leakages are liable to occur at any time and thus cause an explosion.

When it is necessary to use the apparatus at night the generator should be of a sufficient capacity to allow it to be charged and cleaned in daylight and then run through the night.

The generators should be so designed that, when recharging, a back-flow of gas from the gas holder will be automatically prevented, as this will prevent the dangerous escape of gas. The gas should be generated long enough in advance of the exhaustion of the supply already in the

gas holder, to allow all of the blowpipes to be kept going.

Flexible tubing, swinging pipe joints, conical check valves, chains, springs, pulleys and lead or fusible pipings should never be used on the generators, as these are liable to get out of order at any time and cause leakages.

Flash-back Preventer

It is absolutely necessary to have a positive acting flash-back preventer connected to the storage tank. This can easily be constructed, with the proper water shields, screen, etc., that are usually used for this purpose. The water shield is by far the best and the back-flash preventer should thus be of a hydraulic type that is so arranged that the water will be properly retained in the device under all conditions of use.

Mercury shields should be prohibited, at all times and under all conditions, as these have proved themselves to be very unreliable and not a preventative against the flames flashing back.

Combustible oil should never be used in connection with the apparatus, and the liquid seals should be protected from deposits of lime or other substances that are liable to stop their automatic and instantaneous action.

Whenever practicable or possible acetylene generators should be located in a separate building that is dry and open to the circulation of air. They should also be set level and on a good solid foundation and far enough from the walls, or other apparatus, for the operator to easily get around them for charging and cleaning purposes.

The generator tanks, storage tanks, flash-back preventer, and in fact all pipes of the apparatus that come in contact with the acetylene should be made of galvanized iron or steel, as this metal is not affected by any chemical action that might be adduced by the gas. The joints should all be riveted or welded, so they will not become loosened.

Piping

The piping should be arranged so that any moisture will flow back to the generator, and if low points occur they should be drained into drip cups that are permanently closed with screw caps or plugs, and no pet cocks used. Connection should be made with right and left couplings or long-thread nipples with lock nuts. Where unions are a necessity, they should be the kind that do not have gaskets. In piping from the generators to the torches, a pipe smaller than ¾ inch should never be used, and the following list gives the size of pipe that is the safest and most reliable to use for the different amounts of acetylene.

¼-inch pipe,	26 feet long	2 cubic feet per hour
⅜-inch pipe,	30 feet long	4 cubic feet per hour
½-inch pipe,	50 feet long	13 cubic feet per hour
¾-inch pipe,	70 feet long	27 cubic feet per hour
1¼-inch pipe,	100 feet long	50 cubic feet per hour
1½-inch pipe,	150 feet long	65 cubic feet per hour
2 -inch pipe,	200 feet long	125 cubic feet per hour
2½-inch pipe,	300 feet long	190 cubic feet per hour
3 -inch pipe,	450 feet long	335 cubic feet per hour

PIPE CAPACITY FOR WELDING GAS.

Impurities

As it is practically impossible to produce calcium carbide, commercially, that is absolutely pure, it is essential that the gas be sent through a cleaner or scrubber before being used.

There is nearly always present in acetylene a fine dust that is thrown off from the lime when it is in the process of decomposition. This lime dust, being very fine and light, remains in suspension in the gas for hours. Unless the gas is filtered through scrubbers packed with cotton waste, asbestos wool, or like material, the dust is liable to enter the pipe and torch and clog them, as well as cut any stop cocks that might be used. This dust is also liable to get into the welds and thus destroy the homogeneity of the metal and consequently its strength.

When calcium phosphide or silicide is present in the carbide, gases such as phosphoreted or siliciureted hydrogen, might be generated and these are spontaneously inflammable upon contact with the air. Either of these would have to be present in much larger percentages than they have yet been found in the American carbides to make of acetylene an explosive mixture. If air were admitted to the acetylene chamber, however, it might come in contact with either of these two gases and start a combustion, in the acetylene that would develop into an explosion. It is therefore quite essential that air be excluded from the generator storage tank.

The Polymers

In the carbides made in Europe enough phosphoreted hydrogen has been found to produce an irritating vapor of sulphuric acid in the rooms in which the gas is burned. In this country, however, the impurities that have been most often met with are some of the polymers, such as benzine, styrolene, naphthalene, anthracene, tar and oily hydrocarbon. These are the elements into which acetylene splits up in the order named when it is subjected to high temperatures by overheating in the generator; the decomposition then being more complete. At a red heat, carbon is separated in the form of lampblack and hydrogen is set free.

These substances would clog up the pipes and burners and enter the metal in the weld, thus weakening it and producing a poor weld. In the carbide-to-water generators, however, the gas is always kept cool if the generator is properly operated and hence they do not appear.

Ammonia

Acetylene that has been very carefully washed will always show some sulphureted hydrogen and small quantities of ammonia. The ammonia when it comes in contact with copper will favor the production of acetylide of copper and this would make the cocks or valves in the torch, or about the generator, scrubber, etc., turn with difficulty. This, however, as well as the sulphureted hydrogen is easily removed by passing the gas through water.

While the ammonia does not readily attack a polished copper or brass surface and cause acetylide of copper to form, it does attack a surface that has already been corroded or covered with oxide, or one that has file or machine-tool marks on it that are freshly made. Then the ammonia when present in the presence of moisture will cause the coloration peculiar to acetylide of copper.

The gradual corrosion that may be caused by this is a frequent cause of leakage, and brass, bronze or copper parts, that the acetylene may pass through, quickly wear out. This has been very annoying to the manufacturers of welding apparatus and can be overcome by the abolition of any brass, bronze or copper parts.

Compressed Oxygen

For welding purposes there is a choice of two methods of obtaining the oxygen. By one it can be purchased stored in steel bottles at different pressures, and when the gas is used from these the bottles can be returned and refilled. The other method is to generate the oxygen on the premises.

Hitherto it has only been possible to obtain the compressed oxygen in small bottles in which it was stored at a pressure of 2000 pounds per square inch. This method was not considered dangerous, and the railroad companies carried them without any special restriction. Nevertheless accidents did occur from these storage bottles breaking, and with this 2000 pounds pressure behind them, a violent explosion occurred. In several cases lives were lost. The bottles, however, were thoroughly tested and annealed at frequent intervals, and this reduced the danger to a minimum.

It is now possible to buy oxygen in storage tanks or bottles at 300-pound pressure per square inch, and this has greatly reduced the danger from this source. The oxygen obtained in this way, however, is slightly more expensive than that manufactured on the premises, and for that reason many who are installing welding plants are generating their own oxygen.

Generating Oxygen

Several different methods have been devised for generating oxygen, and many different chemicals have been used for this purpose. The chemicals used, however, have been reduced to two, as these are the most economical, and a fairly pure oxygen is generated from them.

Chlorate of potash is burned in a closed

vessel, and this generates oxygen under pressure. To prevent a too rapid combustion, and generation of oxygen, it is necessary to mix 13 pounds of manganese dioxide with 100 pounds of crystallized chlorate of potash. The manganese dioxide, being a refractory material, retards the combustion, and hence the chlorate of potash gives off its oxygen in about the proper volume.

Two methods have been employed for generating oxygen with these chemicals; one is to place them in a closed vessel, and add a little coal or ignition powder, which is lighted to start combustion. The retort in which it is held is then closed and the whole placed in a large tank. As the chlorate of potash gives off its oxygen, the gas is stored in this tank ready for use.

The other method is to inclose the chlorate of potash and manganese dioxide mixture, in an inclosed retort and apply heat from the outside to make the chemicals give off their oxygen and send it through pipes to a storage tank. The heat on the outside of the retort is generally produced by acetylene gas that is piped from the acetylene generator, but any other means of applying the heat gives the same result.

In the generation of oxygen in this way it must be understood that oxygen has a great affinity for carbon, and any carbonaceous matter is much more combustible in the presence of oxygen than under any other condition. Therefore, it is very necessary to keep organic matter such as pieces of wood, paper, coal, charcoal, leather, or any kind of greasy substances away from the chlorate of potash mixture or the generator and especially when charging it.

Compressing Oxygen

In air compressors that are used to compress the oxygen in tanks, it is a case of criminal negligence to use oil of any kind, for lubricating purposes. Several explosions with a fatal ending have occurred from this cause. Compressors used for this purpose should always be lubricated with soap.

Compressors should have all parts that are exposed to the oxygen, made of noncorrosive material. They should be water cooled and of the two-stage type, even for moderate pressures, and should not be located in the same room with acetylene generators or where dust, or other material that is inflammable, is present.

The storage tank should be thoroughly protected with a rust preventative, and these tanks should not be exposed to temperatures that will cause the gases to expand to excessive pressures. Any system of generating oxygen under pressures above 15 pounds per square inch should be prohibited, and below that the apparatus should be constructed with a factor of safety that is not less than eight.

Oxygen generators or storage tanks should not be located in the same room with acetylene generators, as if the two should leak and mix a very explosive mixture would be the result.

Cleaning Out Impurities

After generating oxygen it is necessary to thoroughly clean it by sending it through scrubbers and then into the storage tank. It can only be thoroughly cleaned by sending it through three scrubbers, two of which could be plain water, and the third water in which soda ash has been placed.

One of the impurities of oxygen generated in this way is chlorine. If the oxygen is not thoroughly cleaned, this will remain in suspension in the gas, and pass through the pipes and torch into the metal in the weld, and greatly lessen its efficiency, owing to its not being a material that will go into solution in the melted metal. This chlorine is also injurious to health.

In some of the materials used for ignition powders, in generating oxygen, carbon is produced, and this mixes with the oxygen as an impurity. It is very essential, therefore, that the oxygen be thoroughly cleaned of this element by sending it through the scrubbers mentioned above before storing it for future use.

Hydro-carbons such as gasolene, benzine, naphtha, kerosene, etc., should never be used around the valves, gages, spindles, or any other part of the compressor, or oxygen generating apparatus, as the oxygen is liable to pick up carbon from these and thus become an explosive mixture.

When oxygen is generated and scrubbed in this way it is difficult to obtain a pressure in the storage tank of more than 15 pounds to the square inch. This, however, is sufficient for welding purposes, but when steel is to be cut, higher pressures of oxygen are required, and then it is necessary to use an air compressor for compressing the oxygen.

The carbon dioxide that is present in oxygen that is generated by some of the processes is removed by passing the oxygen through a scrubber that is filled with inert substances, over which a solution of caustic soda has been poured.

How Shall Our Boys Learn a Trade?

By W. D. Graves

A suggestion that the impossibility of allowing an apprentice to make something, to complete a job by himself, as in the old days, may be the reason why he seems unambitious now.

The trade school the more modern way.

We who have wrought as artisans for many years are apt to bemoan the fact that beginners in mechanical plants take less interest than beginners used to take. We complain that they are content to continue in one rut; while we admit that modern conditions, which we deplore, tend to make them so. But as we have grown old, our eyes have become a trifle dimmed and we are a bit too prone to look only along old lines. Let us, then, don our best spectacles, rub a little bear grease on our necks, and look about us.

Though many will call us old fogies for saying it, it is undoubtedly true that the average factory beginner of today does not take as much interest in his work as did the old-time apprentice; but the reason, methinks, is not far to seek. The modern tendency to specialization, carried to the extreme, is bound to drive the true mechanic from detail work. My boy, or yours, is anxious to help build the chicken coop if he can saw, drive nails and generally see the structure grow under his hands; but, if he is put to hold up the ends of boards, to placing shingles for us to nail, or at any detail of the work, he soon wants to go swimming. I can well remember the pride which swelled my boyish bosom as I watched the first pair of wagon wheels which I myself had wholly built, roll their somewhat wabbly way out of the yard. That same feeling could never have come from the knowledge of having well and conscientiously sanded even a million sets of spokes for wheels built by someone else. Forty years ago, while much disagreeable drudgery fell to the lot of the apprentice, he was occasionally put to *making something;* given a job which he could complete and show as his own. It is but rarely that the beginner of today gets a chance to *make something;* to complete a job, and monotony neither attracts nor holds the youngster of real mechanical bent. Of course the size of the plant has much to do with the extent to which specialization is carried, but the system of most plants is distinctly against the youngster learning more than one branch.

It is not the intent to intimate that the boy of today has not as good an opening, in mechanical lines, as he of forty years ago; for he has a far better one. Let us, then, look for that broader opening, instead of keeping our sluggish gaze riv-

eted on the rugged hole through which we crawled. Methods and practice are entirely different from what they were in the days of our apprenticeship, and it naturally follows that the methods of learning should be different.

Those of us who have children at school cannot fail to have noticed the difference in methods of instruction there; the vast difference in the degree of interest taken by the young students. For, indeed, they are students, where we were "dumb driven cattle." If we look in the right place we will see the same difference between the embryo mechanic of today and the one of old; but the place will not be in the factory or mill. The real mechanic of today doesn't work at an automatic machine.

If we want our boys to be soldiers, we do not advise them to enlist as privates, but strive to send them to West Point. If we want them to be mechanics we will send them to industrial schools. Surely one whose business and sole occupation is teaching can be more helpful to a boy than can the village blacksmith, who has to earn his living wholly aside from what he teaches. Nor will we, who have served apprenticeships, be in haste to deny that the apprentice earns all he gets. Just as easily, if need be, can he earn his living working as an automaton in some factory, while he learns a trade under someone whose business is teaching. The whole may be accomplished as quickly, and much better. Almost before we know it, my boy and yours, after a few half-days in the manual-training department of a good public school, will have acquired more mechanical knowledge of present and future value than he would normally get in a month of shop apprenticeship. Perhaps schools deal largely in theory, but theory is essential in order that one may be competent to take charge; and we want our boys to be bosses. That we were taught to swim by being unceremoneously thrown into deep water does not argue that we cannot teach our boys in a gentler manner; teach them so that they will take more kindly to the water and swim lighter.

In the smaller towns, among the smaller shops, are still chances for young men to learn trades much as they did in the years gone by. A few of those who thus learn will, despite the needless hard knocks they get, eventually become foremen; just as some privates become officers, but the vast majority of the real mechanics of tomorrow will have been educated in industrial schools.

Designing Cone Clutches

By C. T. Schaefer

The various kinds of cone clutches used on an automobile with formulas for designing and laying them out.

Among the important parts of the automobile, the clutch occupies a premier position on account of its frequent service, particularly in the case of town cars, taxicabs, delivery wagons and light runabouts used by physicians and salesmen.

Much has been written and said on clutches of all forms and designs and each separate type seems to have been preëminent for a time only to be displaced by another favorite. Among the different styles used the cone type of clutch seems to have held its own and is today the most widely used clutch.

The designs of this clutch are many and varied, each designer using some different form of mechanism. The raybestos and leather-faced cones are most extensively used. The tendency is in favor of the raybestos-faced cone, due to the fact that it will not char or burn when it slips. The leather facing is mostly used with cork inserts, which protect the leather and have the same qualities as raybestos. Springs are invariably placed under the facing to insure gradual engagement.

The cones are generally made of aluminum, as they must be light, owing to the fact that the inertia must be low, when the clutch is disengaged, to facilitate easy and quiet shifting of the gears. This is essential for a quiet and smooth-running car. Foreign designers seem to prefer a pressed-steel cone for its lightness, and this is also used by a few American designers. This type of cone has its disadvantages as well as advantages, the same as the aluminum cone.

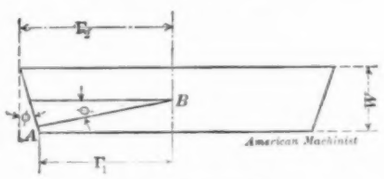
I solved the inertia problem by applying a brake to the clutch when disengaged to keep it from spinning, and at present the majority of clutches are provided with brakes. This is also true of all types and kinds of clutches.

It is a well-known fact that the relative force of the mass must be low to reduce the inertia to a minimum. When no brake is applied and we take into account the fact that the inertia of the mass is proportioned to V^2W (the square of the velocity multiplied by the weight) it is easy enough to see that the diameter plays an important part, especially since the velocity is as follows:

$$V = 2\pi Rn$$

in which

V = Speed of mass in feet per second.
R = Radius of mass in feet (from axis of rotation).
n = Revolutions per second.



CONE CLUTCHES

The angle of the cone also varies in practice, some designers using a large angle with correspondingly larger spring, but from experience gained, an angle of 10 to 12½ degrees seems to give the best satisfaction. The standard among automobile parts manufacturers is 12½ degrees. That this is a good angle has been proved by the large number of cars using it. A simple formula for calculating the horsepower a clutch will transmit was advanced by Charles Schabinger in the *Horseless Age* of Oct. 2, 1907. It is

$$H.P. = \frac{P f r R}{63{,}000 \, Sin. \, \phi}$$

in which

P = Pressure of engaging spring in pounds.
f = Co-efficient of friction of surfaces.
r = Mean radius of cone in inches (see line cut).
$Sin\,\phi$ = Sine of the angle of the clutch.

Transposing the formula to obtain P, we have

$$P = \frac{H.P. \times 63{,}000 \, Sin. \, \phi}{f r R}.$$

The width of the cone may be obtained by the following formula, but the pressure per square inch must not exceed 45 pounds.

$$W = \frac{X}{r \, 2 \, \pi 50},$$

in which

X = Distance A to B (see line cut).
W = Width of cone.

I have found these formulas reliable and have used them in all calculations in the past three years.

The importation of creosote oil into the United States, which in 1905 amounted to about 8,000,000 gallons, had by 1909 grown to nearly 40,000,000 gallons. Out of the total creosote consumption in this country of about 56,000,000 gallons in 1908, 69 per cent. was imported, while in 1903 the total amount used was only 7,700,000 gallons.

Design of Centrifugal Pumps—I

By A. Borsody*

By suitable design the characteristics, or relation of capacity to head, of a centrifugal pump may be made to suit almost any particular conditions of service, so that they are coming into use for a larger variety of purposes.

The characteristics depend upon the vane angle. If the vanes bend backward, an increasing head will produce a decreasing capacity. If the vanes are radial, a variable capacity may be discharged against a constant head. If the vanes bend forward, an increase in head will be followed by an increase in capacity.

Simple formulas and rules are given to aid the designer.

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There are two types of centrifugal pumps in general use. (1) The volute. (2) The turbine. The volute pump derives its name from the shape of its casing which is a "volute;" that is, the cross-sectional area increases toward the discharge in such a proportion, that the velocity of the water in the casing is constant throughout. In Fig. 1 *D* is the volute casing proper. The only running part is called the impeller *E*, which discharges through the whirlpool chamber *W*, into the volute casing proper.

The turbine pump has an annular casing *A*, in Fig. 2. The impeller is surrounded by a stationary guide wheel called the diffusion ring *B*, which receives the water from the impeller *C*, splits it up into a number of independent streams and delivers them radially into the casing. In case of a multi-stage turbine pump the discharge from the first impeller passes through the first diffusion ring, into what is called the channel ring *D*, which turns the water into the entrance of the second impeller, and then the same process is repeated.

Volute pumps are usually low head pumps, used for heads from 5 ft. to about 80 ft. under ordinary conditions. Under special conditions, however, when the necessary high rotative speed is available, heads as high as 125 to 150 feet are easily and efficiently obtained by a volute pump. A single-stage turbine pump is generally used for heads from 80 feet to 125 feet, or even as high as 150 feet, under favorable conditions. If higher heads are required, two or more impellers are used, revolving on the same shaft and discharging the water as shown in Fig. 2, which is a two-stage pump.

Characteristics of Centrifugal Pumps

The general characteristics of centrifugal pumps now on the market and operating at a constant speed, are shown by the curves in Fig. 3.

It will be noted that an increase in the pumping head causes a reduction of capacity and of the horsepower required, and *vice versa*. The general characteristics depend upon the design of the impeller, which can be so constructed as to give any desired results.

Design of the Impeller. (A) Diameter

Referring to Fig. 4, let

AB = Curve of the impeller vane.

$AE = u$ = Tangential velocity of impeller at its periphery, in feet per second.

$AF = c_r$ = Radial velocity at the discharge of the impeller in feet per second.

α = Angle between the tangential velocity u and the relative velocity at discharge, AC.

β = Angle between tangential velocity u and the resultant velocity AD at discharge.

H_1 = Theoretical head in feet.

H = Actual head in feet.

D = Outside diameter of impeller in feet.

N = Revolutions per minute of the impeller.

Then, from Weisbach and Fink

$$H_1 = \frac{u^2}{2g}\left[1 + \frac{\sin.(\alpha+\beta)}{\sin.(\alpha-\beta)}\right].$$

By experiment it was found that the actual head obtained in practice is represented by

$$H = \frac{u^2}{2g \times 1.5}\left[1 + \frac{\sin.(\alpha+\beta)}{\sin.(\alpha-\beta)}\right].$$

Substituting value of $g = 32.2$ and simplifying, we obtain

$$H = \frac{u^2}{96.6} C_1 \qquad (1)$$

in which

$$C_1 = \left[1 + \frac{\sin.(\alpha+\beta)}{\sin.(\alpha-\beta)}\right]. \qquad (2)$$

(B) Discharge Opening of Impeller

Let

Q = Cubic feet liquid discharged per minute.

b = Width of discharge opening at periphery in feet, Fig. 4.

Expressing Q in terms of the radial velocity and the *effective* area of discharge at the periphery of the impeller, with the usual proportions of thickness of vanes, we obtain

$$b = \frac{u}{c_r} \frac{Q}{0.95\ \pi^2 D^2 N}. \qquad (3)$$

The factor 0.95 is a practical figure and represents the ratio of the actually available area, to the theoretical area if there were no vane thickness.

(C) Entrance Opening of Impeller

Let

d = Diameter of impeller entrance in feet, Fig. 4.

b_1 = Width of impeller entrance in feet Fig. 4.

By similar process to that indicated for the discharge opening it can be shown that, with usual proportions of vane thickness at entrance;

$$b_1 = \frac{u_1}{c_{r_1}} \frac{Q}{0.8\ \pi^2 d^2 N} \qquad (4)$$

Here again, the factor 0.8 represents the

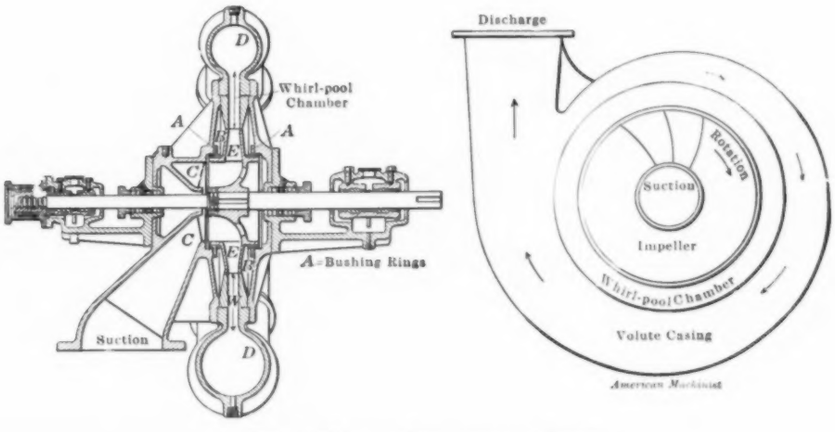

Fig. 1. Volute Centrifugal Pump

ratio of the actually available area to the theoretical area, as usually constructed. In this latter formula, also, u_1 and c_{r_1} refer to the impeller entrance.

The Use of Formulas (1), (2), (3) and (4)

The best value for α is between 155 degrees and 170 degrees, depending upon conditions. For high head pumps, that is for heads from 70 feet to 150 feet per impeller, α should be taken between the limits of 165 degrees and 155 degrees. The higher the head per impeller the lower α should be taken; for 70-feet head α can be taken as 165 degrees and for 150-foot head, α should be about 155 degrees. For low head pumps; heads from 5 feet to 70 feet per impeller, α should be taken between the limits of 170 degrees to 165 degrees. The lower the head per impeller the higher α should be taken; for 5-foot head α should be 170 degrees and for 70-foot head α should be about 165 degrees. Having selected α between the above limits depending upon working conditions, the radial velocity c_r should be chosen. A radial velocity of 8 to 10 feet per second will give good results when handling clear water against moderate heads. The radial velocity should be taken lower in a low-head pump, and higher in a high-head pump. (Head referred to in all cases is head in feet per impeller.) For a head of 5 feet the radial velocity should be as low as 6 feet per second. For a head of 150 feet, it can be taken as high as 12 to 15 feet per second. The above figures hold good for clear water only. If the liquid contains foreign matter, sand or grit, the radial velocity should be taken low in all cases, whether the head is high or low. The more foreign matter the liquid contains, the lower the radial velocity should be taken..

Having selected the proper values for α and for c_r, the designer assumes a trial value for the tangential velocity at the periphery, u, depending upon the required head. Then the velocity diagram is constructed as in Fig. 4, from which the value of β is graphically obtained. Thus we know α and β and from formula (2) the value of C_1 is calculated. Substituting value of C_1 in formula (1), a value for the head H is obtained. If this value of H is too small or too large, in comparison with the required head, assume a new value for u until the calculated head will be equal to the required head. Then this last assumed value for u is the one required in the problem in hand. Knowing u and having been given the available rotative speed N, the diameter of the impeller can be calculated from

$$u = \frac{\pi D N}{60} \text{ or } D = \frac{60\,u}{\pi N} \qquad (5)$$

To find the width of impeller discharge b, use formula (3). The value of u is known, D is calculated as above, N is always given, Q is given and c_r has already been selected. Thus, all the factors are known.

To figure out the width of impeller entrance b_1, use formula (4). The diameter of impeller entrance d is usually taken the same size as the suction pipe, which should be of such size as not to produce a flow of over 8 feet per second. If the liquid contains foreign matter this velocity should be less. The radial velocity at entrance c_{r_1} should be the same as in the suction pipe. u_1 can be easily obtained from

$$u_1 = \frac{\pi d N}{60}.$$

Thus, all the factors are known.

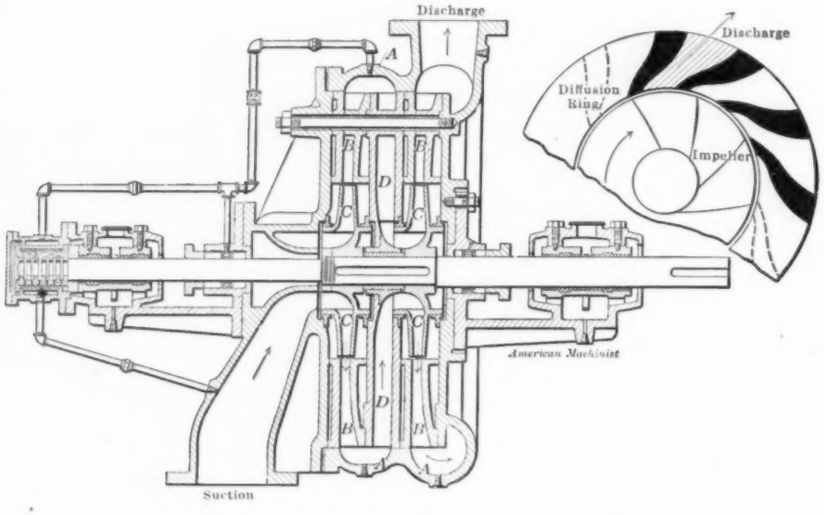

Fig. 2. Section through Two-stage Turbine Pump

Examples of Design

Impeller 1, *Fig.* 5.

Let

$\alpha = 170$ degrees.

$u = 65$ feet per second.

$c_r = 9$ feet per second.

Here it is assumed that a certain diameter impeller is operating at such a rotative speed that

$$u = \frac{\pi D N}{60} = 65,$$

and discharging a quantity of water corresponding to a radial velocity of 9 feet per second. The problem is to find against what head this impeller will be able to deliver the given quantity of water, operating at the given spread.

Constructing the velocity diagram, Fig. 5, it is found that $\beta = 27$ degrees. From formula (2), substituting values of α and β, $C_1 = 0.518$. Substituting value of C_1 in formula (1) and solving for H, we have

$$H = \frac{65^2}{96.6} \times 0.518 \quad 23 \textit{ feet.}$$

Impeller 2, *Fig.* 6.

Let

$\alpha = 90$ degrees.

$u = 65$ feet per second, as before.

$c_r = 9$ feet per second, as before.

From the velocity diagram, $\beta = 7$ degrees 30 minutes and substituting the values of α and β in formula (2), $C_1 = 2$.

From formula (1)

$$H = \frac{65^2}{96.6} \times 2 = 87.5 \textit{ feet.}$$

By changing the value of c_r in the velocity diagram, keeping u = constant and $\alpha = 90$ degrees, it is seen that β will vary with c_r.

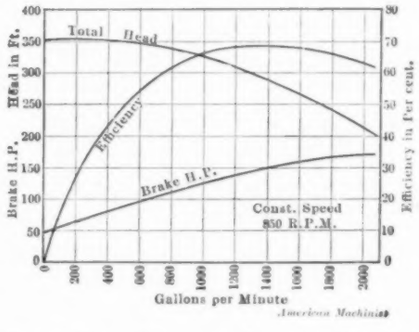

Fig. 3. Characteristic Curves of 8-inch Three-stage Turbine Pump

When $\alpha = 90$ degrees, the value of $\frac{\sin.(\alpha + \beta)}{\sin.(\alpha - \beta)}$ will always be constant, no matter what the value of β. This is shown in a general way as follows:

$$\frac{\sin.(90° + \beta)}{\sin.(90° - \beta)} = \frac{\cos.\beta}{\cos.\beta} = 1 = \textit{constant.}$$

The value of C_1, therefore, will always be equal $= 1 + 1 = 2 =$ constant, and the head H will be constant, no matter

what the value of β, provided u is constant. But as β changes, c_r changes, and therefore: *An impeller with radial vanes ($\alpha = 90$ degrees), operating at a constant speed (u = constant), can deliver a variable quantity against a constant head.* In all other cases the head will vary with the capacity. In the same manner, taking different values for α, the relation of head and vane angle shown in Table 1, are found.

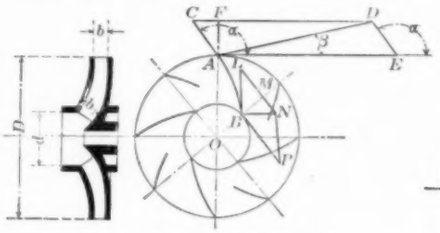

FIG. 4. VELOCITY DIAGRAM

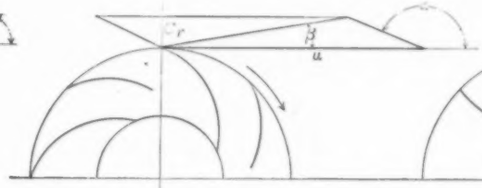

FIG. 5

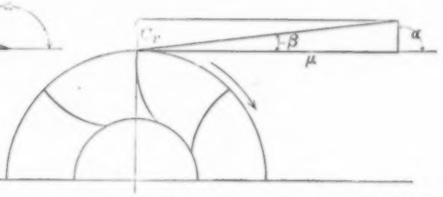

FIG. 6

EFFECT OF VANE ANGLE ON ANGLE OF DISCHARGE

α = Vane Angle, Degrees.	c_r = Radial Velocity, Feet per Second.	u = Tangential Velocity, Feet per Second.	Head, Feet.
170	9	65	23
160	9	65	47.5
135	9	65	75.5
120	9	65	81.0
90	9	65	87.5
60	9	65	94.0

TABLE 1. RELATIONS OF VANE ANGLE AND HEAD, WITH CONSTANT TANGENTIAL VELOCITY AND CONSTANT QUANTITY.

CONCLUSIONS

1. With a constant peripheral speed, u, and a constant discharge c_r the head will depend upon the angle α, of the vane at the periphery. The smaller the angle α, the higher the head, and *vice versa.*

2. From Fig. 7 it is seen that as α is taken smaller, the vanes become less convex in the direction of rotation; that is, they become flatter.

When $\alpha = 90$ degrees, the vanes become radial, and when α is less than 90 degrees, the vanes become concave in the direction of rotation.

3. By analyzing formula (1) for the head, it can be shown that when α is greater than 90 degrees, the vanes being turned away from the direction of rotation (Fig. 7, vanes III and IV) and operating at a constant speed, the *capacity increases* as *the head decreases* and *vice versa.*

4. With radial vanes ($\alpha = 90$ degrees), at a constant speed (Fig. 7, vane II) *a variable capacity* can be delivered against a *constant head.*

5. With impeller vanes turned in the direction of rotation (Fig. 7, vane I), α less than 90 degrees, and operating at a constant speed, the *capacity increases* or *decreases* as the head *increases* or *decreases.*

AXIAL THRUST IN CENTRIFUGAL PUMPS

Axial thrust is primarily caused by unbalanced static pressure on the sides of the impeller.

Taking the normal one-sided impeller, Fig. 8, without balancing holes in the boss chamber B, there will be a thrust in the direction of the arrow, due to the unbalanced pressure on the area $\frac{\pi d^2}{4}$ neglecting the shaft area. The actual thrust will be represented by $T = \frac{\pi d^2}{4}(P - p)$ in which P = pressure at the discharge of the impeller, and p = initial pressure at the impeller entrance. If there is a pressure on the suction of the pump p is positive, and if the pump operates on a suction lift p is negative, therefore when there is pressure on suction,

$$T = \frac{\pi d^2}{4}(P - p).$$

When there is a suction lift,

$$T = \frac{\pi d^2}{4}(P - (-p)) = \frac{\pi d^2}{4}(P + p).$$

In either case the thrust will be in the direction of the arrow, and it will be greater when operating on a suction lift than when there is a pressure on the inlet.

If the boss chamber B is connected with the entrance chamber S by means of balancing holes, Fig. 9, the pressure in the two chambers will be equalized. Assuming that both bushing rings D_1 and D_2 leak equally, thus maintaining equal pressures in chambers A_1 and A_2, the impeller will be perfectly balanced axially and there will be no thrust. But in practice, after the pump has been in service some time, the two bushing rings will invariably leak unequally, due to unequal wear and will consequently disturb the axial balance, by making the pressures in chambers A_1 and A_2 unequal, causing axial thrust in one or the other direction. Besides unequal bushing ring losses, the following elements will enter, which will tend to produce thrust.

1. Impeller being out of line with opening in casing or guide ring into which it discharges.

2. The reaction of the force exerted by the impeller blades on the water, when the blades are not exactly parallel with the axis.

3. High velocity head due to extremely high lifts.

Axial thrust may be balanced fairly well when the pump is new and in good condition, but thrust will develop as the pump continues in service. A double suction impeller will be balanced, provided both bushing rings leak equally, but this is not the case in practice. The best practical way to take care of the unbalanced thrust is to provide the pump with a positive mechanical thrust bearing which will take up the unbalanced thrust in either direction. The marine thrust bearing is generally used by manufacturers. Thrust collars are turned on the pump shaft; these collars run in a babbitted bushing and are automatically lubricated. This is shown in the sectional view of turbine pump Fig. 2, or volute pump, Fig. 1.

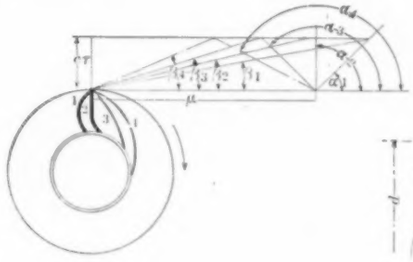

FIG. 7. SHAPES OF VANES OF VARIOUS ANGLES

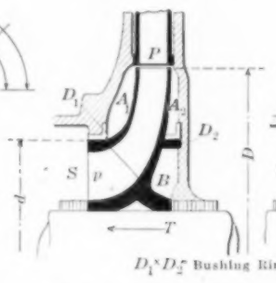

FIG. 8. UNBALANCED IMPELLER

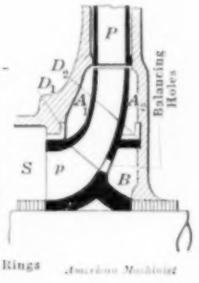

FIG. 9. BALANCING HOLES IN IMPELLER

A recent bulletin, published by the Bureau of Mines, calls attention to the many mine accidents caused by the explosibility of coal dust rather than firedamp, the usual attributed cause of such accidents. The bulletin states that only within comparatively few years has the dry dust of bituminous and lignitic coal been generally recognized as an explosive agent more insidious, threatening and deadly to the miner than firedamp.

Pressing Caskets of Metal

Editorial Correspondence

The use of electrically driven power presses for manufacturing metal caskets. How the casket body is pressed in two operations with a water seal groove around the top edge.

A new application that has been given the power press is that of manufacturing burial caskets out of sheet metal. The Montross Metal Casket Company, of Hagerstown, Md., has injected some new ideas into this industry by using huge presses in which to shape a water-sealed sheet-metal casket, and then placing this inside of a shell or carrier that is also pressed out of sheet metal.

This carrier is highly finished in any color desired or to represent any kind of wood. On it are placed the highly ornamental corners, handles and other decorations, and when the funeral arrives at the burial place the casket can be lifted out of the carrier and deposited in the vault or in the grave as desired. The carrier, with its expensive ornamental work, can then be taken back to the undertaker's to be used for other funerals, as this can be rented for the occasion, instead of bought and destroyed, which is the usual method.

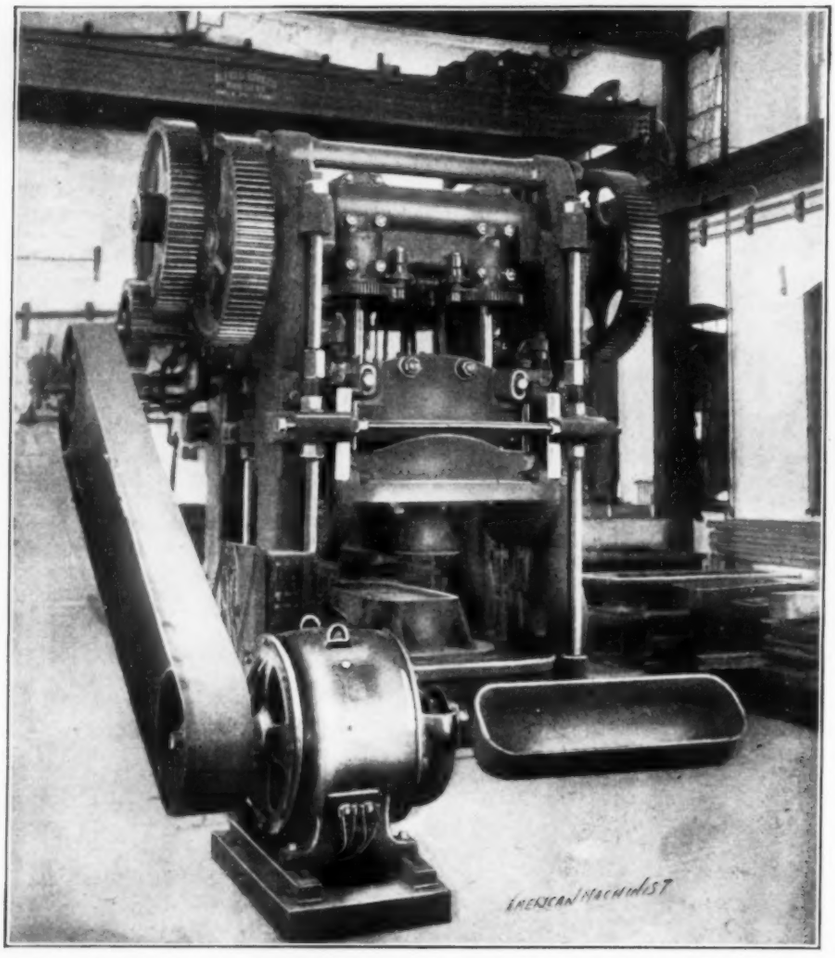

FIG. 1. LARGE PRESS WITH DIES SET FOR PRESSING BODY OF CASKET. END VIEW

In Fig. 1 is shown the press as it is set up for the last operation in shaping the body of the inner casket. As will be seen, it is motor-driven, and an overhead electric crane is used for conveying the dies to and from the press and placing them in position. A finished casket body is shown in front of the press.

This is drawn in two operations. The first operation gives it a rough shape, after which it is thoroughly annealed and then drawn as shown. The sides are from 10 to 12 inches high and turned up from the bottom at a right angle, with the four corners rounded. Around the top edge is formed a deep narrow groove to hold water, and into this the cover fits, thus forming the water seal. After forming to shape in the press the edge of the casket body is trimmed in trimming dies, the body shown being one that had been thus trimmed.

A slightly smaller press is used for pressing the casket covers, as shown in Fig. 2. This cover has very little depth and hence is a simple job that is done in one operation. The edge is given an ornamental shape to make it pleasing to the eye. One of the covers, as it leaves the press, is shown lying on the floor in front of the press. From here it goes to the trimming dies where the excess of metal on the edge is trimmed off.

FIG. 2. PRESSING COVER. SIDE VIEW

Many different sizes of caskets are made in these presses, as their cost of

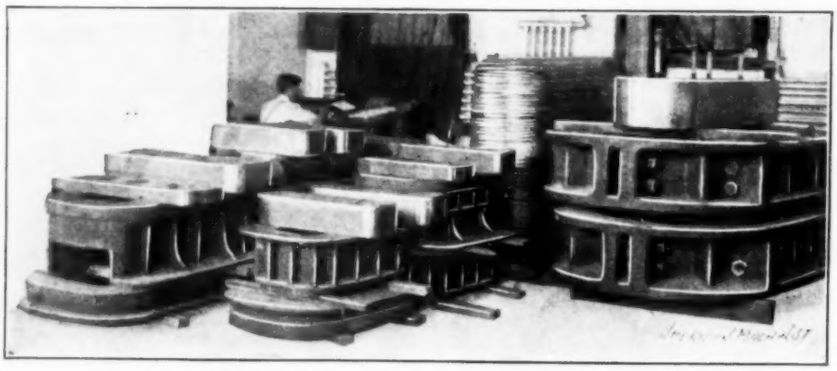

FIG. 3. MALE AND FEMALE DIES FOR PRESSING CASKETS

manufacture is considerably cheaper than the wooden casket. They are also more durable, can be given equally as good a finish and made every bit as ornamental. A group of the male and female dies that are used in shaping up these caskets is shown in Fig. 3. As will be seen, the dies are capable of pressing any size of caskets from those for the small baby to those for the full grown person, and there is very little wear on the dies.

Railroad Pneumatic Shop Tools

By Fred H. Colvin

Some ingenious applications of pneumatic tools to railroad shop work.

Rolling flat seams; staybolt breakers and flue-swaging machine, a few of the illustrations.

Fig. 1 shows a very ingenious device which has been made by the tin-shop foreman, William Moffatt, for the sheet-metal department in the Beech Grove shops of the Big Four railroad for rolling flat seams which have been previously turned. This is for such work as boiler jackets, where it is desirable to secure a perfectly flat seam. It is a very simple machine, consisting of the loop framework shown, with the four-wheeled trolley or crosshead in between. The rolling-wheel crosshead is controlled by a long air cylinder at the right of the column, and as soon as the seam is in place, air is admitted to this, and the rollers make a perfectly finished seam without any tendency to buckle. It will be noted that the framework is carefully designed to stand the strains imposed.

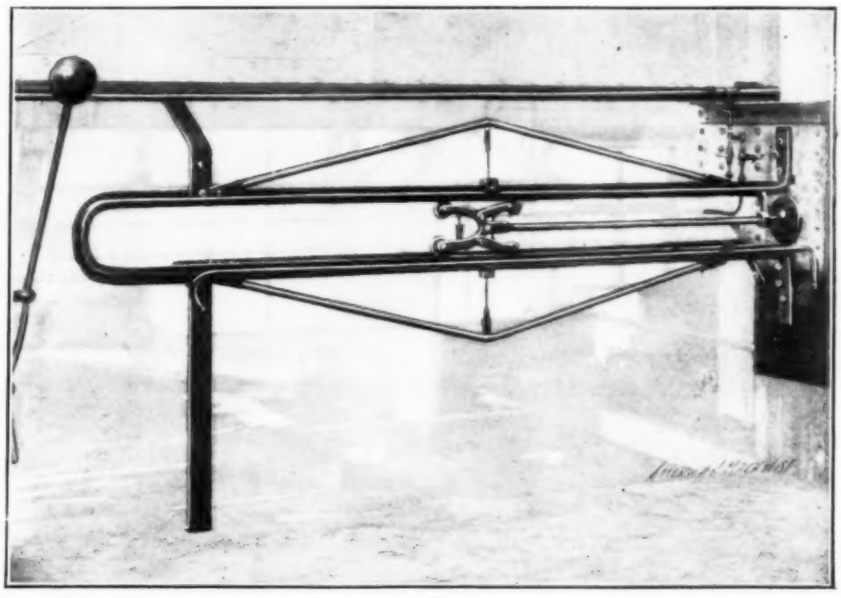

FIG. 1. MACHINE FOR ROLLING FLAT SEAM JOINTS

PNEUMATIC RAM OR STAYBOLT BREAKER

While there is nothing new about pneumatic staybolt breakers, the illustration, Fig. 2, shows the construction of one of these, which has proved very successful in this shop. The ram or flying piston is clearly shown, being 3½ inches in diameter. The shock of the blow is very largely taken by the long coil spring shown at the back, which makes it easy for the operator to handle. The operating handle and the three-way cock are conveniently located, and the whole machine has proved very successful in breaking out old tables and in similar work.

FLUE SWAGING AND SCARFING

Fig. 3 shows a pneumatic flue-swaging machine; the details of construction are so clearly shown by the partial sectional view as to require practically no explanation. All necessary dimensions are given so that a similar machine can be easily constructed if desired.

Fig. 4 has proved very convenient in

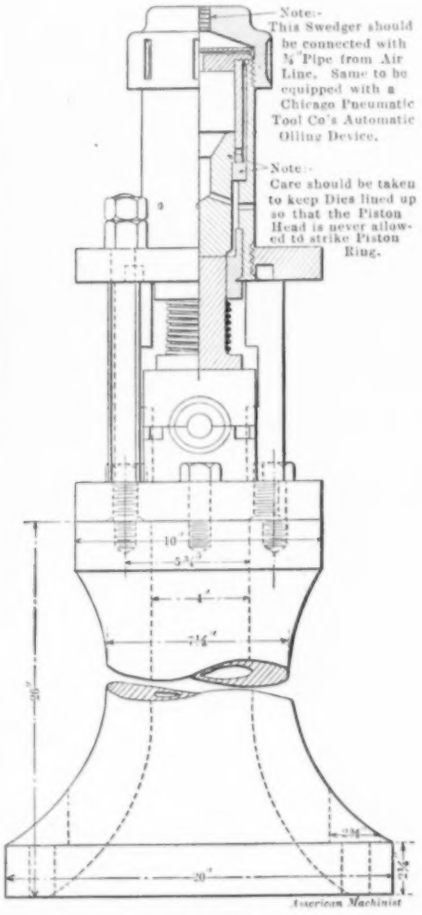
Note:-
This Swedger should be connected with ¾" Pipe from Air Line. Same to be equipped with a Chicago Pneumatic Tool Co's Automatic Oiling Device.
Note:-
Care should be taken to keep Dies lined up so that the Piston Head is never allowed to strike Piston Ring.
10"
5 3/4"
4"
7 1/4"
20"
2 3/4"
American Machinist

FIG. 3. DETAILS OF FLUE-SWAGING MACHINE

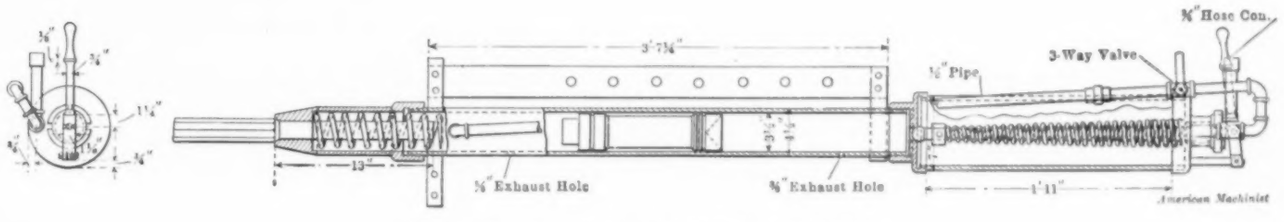

FIG. 2. PNEUMATIC RAM OR STAYBOLT BREAKER

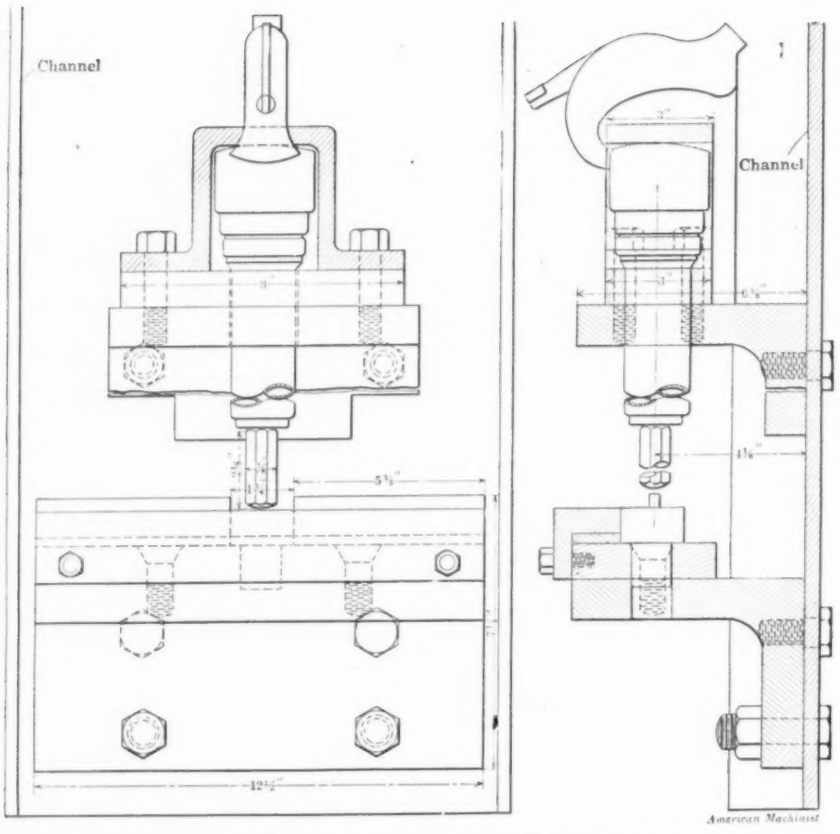

FIG. 4. PNEUMATIC SWEDGER FOR SCARFING COPPER FERRULES

the swaging or scarfing copper for boiler-tube ferrules. It consists of a regular short-stroke pneumatic hammer, mounted as shown on one of the columns which support the shop roof. It is at a convenient hight for the operator, who simply places the piece of copper to be scarfed on the small anvil shown and presses the trigger in the hammer handle. This does the work easily and quickly, and is much more satisfactory than any hand hammering can be.

Table of Pitch Diameters

The accompanying tables, prepared by George W. Klages, will be found extremely useful by all who have to do with any calculations regarding gears. These give the pitch diameter without any figuring, of gears having a circular pitch from 1/7 inch to 2 inches and the odd pitches given, such as ⅛ inch and 13/16 inch, will be found very useful in many cases.

The gears run from 11 to 100 teeth and while only the pitch diameter is given in the tables, the outside diameter for gears up to 98 teeth can be found by following the note at the bottom of the tables.

The small table giving standard addendum, depth of space below pitch and the whole depth of tooth for all these pitches, at a glance, will also be found of value.

The United States Consul at Buenos Aires, Argentina, reports a large number of high-grade automobiles used in that city, but says that on account of the bad roads or lack of roads their use is limited. He suggests that for this service a car having a high clearance, such as the buggy type, ought to find a market.

Gas Producer Progress in Mexico

By J. W. Hall*

Opportunity of gas producer apparatus of simple design in Mexico

Reliability the chief requisite.

*Vice-president and manager of Fundicion de Fierro (Iron Foundry), San Luis Potosi, Mexico.

Producer gas and the gas engine must be the future means of creating industrial power in Mexico. This applies especially to the mining industry, due to the scarcity of fuel or the necessity of a long haul to secure it, and taking into consideration the low-grade ores which require considerable power to treat them, and the transportation of fuel 40 to 50 miles on mule back, places many a good proposition out of the question.

But consider the possibilities and the changes that can be made with the introduction of producer gas in this line of industry alone, not to speak of agriculture and manufacturing. It is safe to state that when producer gas has reached perfection the demand will far exceed the supply.

We must look to the suction gas producer as the principal source of power in Mexico, and in order to have it become universally used in a country where the majority of people who consume power are inexperienced, the producer and gas engine must be of simple and durable construction, as well as supply clean and pure gas free from tar, that the consumer may be assured that his plant will operate with the continuity and reliability of a steam engine. In order to produce this kind of gas we must not depend entirely upon the scrubber. We must produce the gas almost clean and free from tar, or we shall find a great percentage of tar in the cylinder and valves, and encounter the delays and troubles consequent thereto.

I have made some tests with a down-draft producer, taking out the gas through the hottest part of the fire, in order to obviate tar in the engine. By this process I produce gas free from tar, converting this rich fuel into gas instead of taking it into the engine, and also avoid the excessive use of oil in an endeavor to dissolve it. Therefore, in order to have the gas engine reach the highest state of efficiency we must supply it with clean gas.

My sad experience in Mexico with many engines using producer gas has been that they would run but a few days, be shut down and cylinder heads taken off and valves removed and cleaned. The class of producer gas in Mexico should be such as will obviate these difficulties and as soon as this point has been reached we will be unable to supply the Mexican demand alone for this class of power.

My advice is not to send tar producers to Mexico, as only first-class machinery will be purchased there. Mexico can pride herself on having some of the finest plants in North America, and we must not lose sight of the fact that only the best is wanted in the land of the Aztecs.

Circular pitch.....	1/4"	5/16"	3/8"	7/16"	1/2"	9/16"	5/8"	11/16"	3/4"	13/16"	7/8"	1"	1 1/8"	1 1/4"	1 3/8"	1 1/2"	1 3/4"	2"	.....Circular pitch
No. of Teeth.	Pitch Diameter.																		No. of Teeth.
11	0.500	0.584	0.700	0.875	1.094	1.167	1.313	1.532	1.751	1.970	2.188	2.407	2.626	2.845	3.064	3.501	3.939	4.377	5.252	6.127	7.003	11
12	0.546	0.637	0.764	0.955	1.194	1.273	1.432	1.671	1.910	2.149	2.387	2.626	2.865	3.103	3.342	3.820	4.297	4.775	5.730	6.684	7.639	12
13	0.591	0.690	0.828	1.035	1.293	1.379	1.552	1.810	2.069	2.328	2.586	2.845	3.103	3.362	3.621	4.138	4.655	5.172	6.207	7.241	8.276	13
14	0.637	0.743	0.891	1.114	1.393	1.485	1.671	1.950	2.228	2.507	2.785	3.064	3.342	3.621	3.899	4.456	5.013	5.570	6.684	7.798	8.913	14
15	0.682	0.796	0.955	1.194	1.492	1.592	1.790	2.089	2.387	2.686	2.984	3.283	3.581	3.879	4.178	4.775	5.371	5.968	7.162	8.356	9.549	15
16	0.728	0.849	1.019	1.273	1.591	1.698	1.910	2.228	2.546	2.865	3.183	3.501	3.820	4.138	4.456	5.093	5.730	6.366	7.639	8.913	10.186	16
17	0.773	0.902	1.082	1.353	1.691	1.804	2.029	2.367	2.706	3.044	3.382	3.720	4.058	4.397	4.735	5.411	6.088	6.764	8.117	9.470	10.822	17
18	0.819	0.955	1.146	1.432	1.790	1.910	2.148	2.507	2.865	3.223	3.581	3.939	4.297	4.655	5.013	5.730	6.446	7.162	8.594	10.027	11.459	18
19	0.864	1.008	1.210	1.512	1.890	2.016	2.268	2.646	3.024	3.402	3.780	4.158	4.536	4.914	5.292	6.048	6.804	7.560	9.072	10.584	12.096	19
20	0.909	1.061	1.273	1.592	1.989	2.122	2.387	2.785	3.183	3.581	3.979	4.377	4.775	5.172	5.570	6.366	7.162	7.958	9.549	11.141	12.732	20
21	0.955	1.114	1.337	1.671	2.089	2.228	2.507	2.924	3.342	3.760	4.178	4.596	5.013	5.431	5.849	6.684	7.520	8.356	10.027	11.698	13.369	21
22	1.000	1.167	1.401	1.751	2.188	2.334	2.626	3.064	3.501	3.939	4.377	4.814	5.252	5.690	6.127	7.003	7.878	8.753	10.504	12.255	14.006	22
23	1.046	1.220	1.464	1.830	2.288	2.440	2.745	3.203	3.660	4.118	4.576	5.033	5.491	5.948	6.406	7.321	8.236	9.151	10.982	12.812	14.642	23
24	1.091	1.273	1.528	1.910	2.387	2.546	2.865	3.342	3.820	4.297	4.775	5.252	5.730	6.207	6.684	7.639	8.594	9.549	11.459	13.369	15.279	24
25	1.137	1.326	1.592	1.989	2.487	2.653	2.984	3.481	3.979	4.476	4.974	5.471	5.968	6.466	6.963	7.958	8.952	9.947	11.937	13.926	15.915	25
26	1.182	1.379	1.655	2.069	2.586	2.759	3.103	3.621	4.138	4.655	5.172	5.690	6.207	6.724	7.241	8.276	9.311	10.345	12.414	14.483	16.552	26
27	1.228	1.432	1.719	2.149	2.686	2.865	3.223	3.760	4.297	4.834	5.371	5.909	6.446	6.983	7.520	8.594	9.669	10.743	12.891	15.040	17.189	27
28	1.273	1.485	1.783	2.228	2.785	2.971	3.342	3.899	4.456	5.013	5.570	6.127	6.684	7.241	7.798	8.913	10.027	11.141	13.369	15.597	17.825	28
29	1.319	1.538	1.846	2.308	2.885	3.077	3.462	4.038	4.615	5.192	5.769	6.346	6.923	7.500	8.077	9.231	10.385	11.539	13.846	16.154	18.462	29
30	1.364	1.592	1.910	2.387	2.984	3.183	3.581	4.178	4.775	5.371	5.968	6.565	7.162	7.759	8.356	9.549	10.743	11.937	14.324	16.711	19.099	30
31	1.410	1.645	1.973	2.467	3.084	3.289	3.700	4.317	4.934	5.551	6.167	6.784	7.401	8.017	8.634	9.868	11.101	12.334	14.801	17.268	19.735	31
32	1.455	1.698	2.037	2.546	3.183	3.395	3.820	4.456	5.093	5.730	6.366	7.003	7.639	8.276	8.913	10.186	11.459	12.732	15.279	17.825	20.372	32
33	1.501	1.751	2.101	2.626	3.283	3.501	3.939	4.595	5.252	5.909	6.565	7.222	7.878	8.535	9.191	10.504	11.817	13.130	15.756	18.382	21.008	33
34	1.546	1.804	2.164	2.706	3.382	3.607	4.058	4.735	5.411	6.088	6.764	7.440	8.117	8.793	9.470	10.822	12.175	13.528	16.234	18.939	21.645	34
35	1.592	1.857	2.228	2.785	3.482	3.714	4.178	4.874	5.570	6.267	6.963	7.659	8.356	9.052	9.748	11.141	12.533	13.926	16.711	19.496	22.282	35
36	1.637	1.910	2.292	2.865	3.581	3.820	4.297	5.013	5.729	6.446	7.162	7.878	8.594	9.311	10.027	11.459	12.892	14.324	17.189	20.053	22.918	36
37	1.683	1.963	2.355	2.944	3.681	3.926	4.417	5.152	5.889	6.625	7.361	8.097	8.833	9.569	10.305	11.777	13.250	14.722	17.666	20.611	23.555	37
38	1.728	2.016	2.419	3.024	3.780	4.032	4.536	5.292	6.048	6.804	7.560	8.316	9.072	9.828	10.584	12.096	13.608	15.120	18.144	21.168	24.192	38
39	1.773	2.069	2.483	3.103	3.880	4.138	4.655	5.431	6.207	6.983	7.759	8.535	9.310	10.086	10.862	12.414	13.966	15.518	18.621	21.725	24.828	39
40	1.819	2.122	2.546	3.183	3.979	4.244	4.775	5.570	6.366	7.162	7.958	8.753	9.549	10.345	11.141	12.732	14.324	15.915	19.099	22.282	25.465	40
41	1.864	2.175	2.610	3.263	4.078	4.350	4.894	5.710	6.525	7.341	8.157	8.972	9.788	10.604	11.419	13.051	14.682	16.313	19.576	22.839	26.101	41
42	1.910	2.228	2.674	3.342	4.178	4.456	5.013	5.849	6.684	7.520	8.356	9.191	10.027	10.862	11.698	13.369	15.040	16.711	20.053	23.396	26.738	42
43	1.955	2.281	2.737	3.422	4.277	4.562	5.133	5.988	6.844	7.699	8.555	9.410	10.265	11.121	11.976	13.687	15.398	17.109	20.531	23.953	27.375	43
44	2.001	2.334	2.801	3.501	4.377	4.668	5.252	6.127	7.003	7.878	8.754	9.629	10.504	11.380	12.255	14.006	15.756	17.507	21.008	24.510	28.011	44
45	2.046	2.387	2.865	3.581	4.476	4.775	5.372	6.267	7.162	8.057	8.952	9.848	10.743	11.638	12.533	14.324	16.114	17.905	21.486	25.067	28.648	45
46	2.092	2.440	2.928	3.661	4.576	4.881	5.491	6.406	7.321	8.236	9.151	10.067	10.982	11.897	12.812	14.642	16.472	18.303	21.963	25.624	29.284	46
47	2.137	2.493	2.992	3.740	4.675	4.987	5.610	6.545	7.480	8.415	9.350	10.285	11.220	12.155	13.090	14.961	16.831	18.701	22.441	26.181	29.921	47
48	2.183	2.546	3.056	3.820	4.775	5.093	5.730	6.684	7.639	8.594	9.549	10.504	11.459	12.414	13.369	15.279	17.189	19.099	22.918	26.738	30.558	48
49	2.228	2.599	3.119	3.899	4.874	5.199	5.849	6.824	7.799	8.773	9.748	10.723	11.698	12.673	13.647	15.597	17.547	19.496	23.396	27.295	31.194	49
50	2.274	2.653	3.183	3.979	4.974	5.305	5.968	6.963	7.958	8.952	9.947	10.942	11.937	12.931	13.926	15.915	17.905	19.894	23.873	27.852	31.831	50
51	2.319	2.706	3.247	4.058	5.073	5.411	6.088	7.102	8.117	9.132	10.146	11.161	12.175	13.190	14.204	16.234	18.263	20.292	24.351	28.409	32.468	51
52	2.365	2.759	3.310	4.138	5.173	5.517	6.207	7.241	8.276	9.311	10.345	11.380	12.414	13.449	14.483	16.552	18.621	20.690	24.828	28.966	33.104	52
53	2.410	2.812	3.374	4.218	5.272	5.623	6.327	7.381	8.435	9.490	10.544	11.598	12.653	13.707	14.762	16.870	18.979	21.088	25.306	29.523	33.741	53
54	2.456	2.865	3.438	4.297	5.371	5.729	6.446	7.520	8.594	9.669	10.743	11.817	12.891	13.966	15.040	17.189	19.337	21.486	25.783	30.080	34.377	54
55	2.501	2.918	3.501	4.377	5.471	5.836	6.565	7.659	8.753	9.848	10.942	12.036	13.130	14.224	15.319	17.507	19.695	21.884	26.260	30.637	35.014	55
56	2.546	2.971	3.565	4.456	5.570	5.942	6.685	7.798	8.913	10.027	11.141	12.255	13.369	14.483	15.597	17.825	20.053	22.282	26.738	31.194	35.651	56
57	2.592	3.024	3.629	4.536	5.670	6.048	6.804	7.938	9.072	10.206	11.340	12.474	13.608	14.742	15.876	18.144	20.412	22.680	27.215	31.751	36.287	57
58	2.637	3.077	3.692	4.615	5.769	6.154	6.923	8.077	9.231	10.385	11.539	12.693	13.846	15.000	16.154	18.462	20.770	23.077	27.693	32.318	36.924	58
59	2.683	3.130	3.756	4.695	5.869	6.260	7.043	8.216	9.390	10.564	11.738	12.911	14.085	15.259	16.433	18.780	21.128	23.475	28.170	32.865	37.561	59
60	2.728	3.183	3.820	4.775	5.968	6.366	7.162	8.355	9.549	10.743	11.937	13.130	14.324	15.518	16.711	19.099	21.486	23.873	28.648	33.422	38.197	60

Pitch Diameters of Gears When Circular Pitch Is Given

The Outside Diameter of a Gear Whose Addendum Is Standard Is the Same as the Pitch Diameter of a Gear Having Two More Teeth.

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Circular pitch	1"	¾"	⅝"	½"	9/16"	⅜"	7/16"	⅝"	5/16"	¼"	3/16"	⅛"	5/32"	1/16"	1"	1¼"	1½"	1¾"	1¾"	2"	Circular pitch
No. of Teeth.	Pitch Diameter.																				No. of Teeth.
61	2.774	3.236	3.883	4.854	6.068	6.472	7.281	8.495	9.708	10.922	12.136	13.349	14.563	15.776	16.990	19.417	21.844	24.271	29.125	33.980	38.834	61
62	2.819	3.289	3.947	4.934	6.167	6.578	7.401	8.334	9.868	11.101	12.334	13.568	14.801	16.035	17.268	19.735	22.202	24.669	29.603	34.537	39.470	62
63	2.865	3.342	4.011	5.013	6.267	6.684	7.520	8.773	10.027	11.280	12.533	13.787	15.040	16.293	17.547	20.053	22.560	25.067	30.080	35.094	40.107	63
64	2.910	3.395	4.074	5.093	6.366	6.790	7.639	8.913	10.186	11.459	12.732	14.006	15.279	16.552	17.825	20.372	22.918	25.465	30.558	35.651	40.744	64
65	2.956	3.448	4.138	5.173	6.466	6.897	7.759	9.052	10.345	11.638	12.931	14.224	15.518	16.811	18.104	20.690	23.276	25.863	31.035	36.208	41.380	65
66	3.001	3.501	4.202	5.252	6.565	7.003	7.878	9.191	10.504	11.817	13.130	14.443	15.756	17.069	18.382	21.008	23.634	26.261	31.513	36.765	42.017	66
67	3.047	3.554	4.265	5.332	6.665	7.109	7.998	9.330	10.663	11.996	13.329	14.662	15.995	17.328	18.661	21.327	23.993	26.658	31.990	37.322	42.653	67
68	3.092	3.607	4.329	5.411	6.764	7.215	8.117	9.470	10.822	12.175	13.528	14.881	16.234	17.586	18.939	21.645	24.351	27.056	32.468	37.879	43.290	68
69	3.138	3.660	4.393	5.491	6.864	7.321	8.236	9.609	10.982	12.354	13.727	15.100	16.472	17.845	19.218	21.963	24.709	27.454	32.945	38.436	43.927	69
70	3.183	3.714	4.456	5.570	6.963	7.427	8.356	9.748	11.141	12.533	13.926	15.319	16.711	18.104	19.496	22.282	25.067	27.852	33.422	38.993	44.563	70
71	3.229	3.767	4.520	5.650	7.063	7.533	8.475	9.887	11.300	12.713	14.125	15.537	16.950	18.362	19.775	22.600	25.425	28.250	33.900	39.550	45.200	71
72	3.274	3.820	4.584	5.730	7.162	7.639	8.594	10.027	11.459	12.892	14.324	15.756	17.189	18.621	20.053	22.918	25.783	28.648	34.377	40.107	45.837	72
73	3.320	3.873	4.647	5.809	7.261	7.745	8.714	10.166	11.618	13.071	14.523	15.975	17.427	18.880	20.332	23.237	26.141	29.046	34.855	40.664	46.473	73
74	3.365	3.926	4.711	5.889	7.361	7.851	8.833	10.305	11.777	13.250	14.722	16.194	17.666	19.138	20.611	23.555	26.499	29.444	35.332	41.221	47.110	74
75	3.410	3.979	4.775	5.968	7.460	7.958	8.952	10.444	11.936	13.429	14.921	16.413	17.905	19.397	20.889	23.873	26.857	29.842	35.810	41.778	47.746	75
76	3.456	4.032	4.838	6.048	7.560	8.064	9.072	10.584	12.096	13.608	15.120	16.632	18.144	19.655	21.168	24.192	27.215	30.239	36.287	42.335	48.383	76
77	3.501	4.085	4.902	6.127	7.659	8.170	9.191	10.723	12.255	13.787	15.319	16.850	18.382	19.914	21.446	24.510	27.574	30.637	36.765	42.892	49.020	77
78	3.547	4.138	4.966	6.207	7.759	8.276	9.311	10.862	12.414	13.966	15.518	17.069	18.621	20.173	21.725	24.828	27.932	31.035	37.242	43.449	49.656	78
79	3.592	4.191	5.029	6.287	7.858	8.382	9.430	11.001	12.573	14.145	15.717	17.288	18.860	20.431	22.003	25.146	28.290	31.433	37.720	44.006	50.293	79
80	3.638	4.244	5.093	6.366	7.958	8.488	9.549	11.141	12.732	14.324	15.915	17.507	19.099	20.690	22.282	25.465	28.648	31.831	38.197	44.563	50.930	80
81	3.683	4.297	5.156	6.446	8.057	8.594	9.669	11.280	12.891	14.503	16.114	17.726	19.337	20.949	22.560	25.783	29.006	32.229	38.675	45.120	51.566	81
82	3.729	4.350	5.220	6.525	8.157	8.700	9.788	11.419	13.051	14.682	16.313	17.945	19.576	21.207	22.839	26.101	29.364	32.627	39.152	45.677	52.203	82
83	3.774	4.403	5.284	6.605	8.256	8.806	9.907	11.558	13.210	14.861	16.512	18.163	19.815	21.466	23.117	26.420	29.722	33.025	39.629	46.234	52.839	83
84	3.820	4.456	5.347	6.684	8.356	8.912	10.027	11.698	13.369	15.040	16.711	18.382	20.053	21.725	23.396	26.738	30.080	33.423	40.107	46.972	53.476	84
85	3.865	4.509	5.411	6.764	8.455	9.019	10.146	11.837	13.528	15.229	16.910	18.601	20.292	21.983	23.674	27.056	30.438	33.820	40.584	47.349	54.113	85
86	3.911	4.562	5.475	6.844	8.555	9.125	10.265	11.976	13.687	15.398	17.109	18.820	20.531	22.242	23.953	27.375	30.796	34.218	41.062	47.906	54.749	86
87	3.956	4.615	5.538	6.923	8.654	9.231	10.385	12.116	13.846	15.577	17.308	19.039	20.770	22.500	24.231	27.693	31.155	34.616	41.539	48.463	55.386	87
88	4.002	4.668	5.602	7.003	8.753	9.337	10.504	12.255	14.005	15.756	17.507	19.258	21.008	22.759	24.510	28.011	31.513	35.014	42.017	49.020	56.023	88
89	4.047	4.721	5.666	7.082	8.853	9.443	10.624	12.394	14.165	15.935	17.706	19.477	21.247	23.018	24.788	28.330	31.871	35.412	42.494	49.577	56.659	89
90	4.093	4.775	5.729	7.162	8.952	9.549	10.743	12.533	14.324	16.114	17.905	19.695	21.486	23.276	25.067	28.648	32.229	35.810	42.972	50.134	57.296	90
91	4.138	4.828	5.793	7.242	9.052	9.655	10.862	12.673	14.483	16.293	18.104	19.914	21.725	23.535	25.345	28.966	32.587	36.208	43.449	50.691	57.932	91
92	4.184	4.881	5.857	7.321	9.151	9.761	10.982	12.812	14.642	16.473	18.303	20.133	21.963	23.794	25.624	29.284	32.945	36.606	43.927	51.248	58.569	92
93	4.229	4.934	5.920	7.401	9.251	9.867	11.101	12.951	14.801	16.652	18.502	20.352	22.202	24.052	25.902	29.603	33.303	37.004	44.404	51.805	59.206	93
94	4.274	4.987	5.984	7.480	9.350	9.973	11.220	13.090	14.960	16.831	18.701	20.571	22.441	24.311	26.181	29.921	33.661	37.401	44.882	52.362	59.842	94
95	4.320	5.040	6.048	7.560	9.450	10.080	11.340	13.230	15.120	17.010	18.900	20.790	22.679	24.569	26.459	30.239	34.019	37.799	45.359	52.919	60.479	95
96	4.365	5.093	6.111	7.639	9.549	10.186	11.459	13.369	15.279	17.189	19.099	21.008	22.918	24.828	26.738	30.558	34.377	38.197	45.837	53.476	61.115	96
97	4.411	5.146	6.175	7.719	9.649	10.292	11.578	13.508	15.438	17.368	19.298	21.227	23.157	25.087	27.016	30.876	34.736	38.595	46.314	54.033	61.752	97
98	4.456	5.199	6.239	7.799	9.748	10.398	11.698	13.648	15.597	17.547	19.496	21.446	23.396	25.345	27.295	31.194	35.094	38.993	46.791	54.590	62.389	98
99	4.502	5.252	6.302	7.878	9.848	10.504	11.817	13.787	15.756	17.726	19.695	21.665	23.634	25.604	27.573	31.513	35.452	39.391	47.269	55.147	63.025	99
100	4.547	5.305	6.366	7.958	9.947	10.610	11.937	13.926	15.915	17.905	19.894	21.884	23.873	25.863	27.852	31.831	35.810	39.789	47.746	55.704	63.662	100

Standard Addendum, Depth of Space below Pitch Line, and Whole Depth of Tooth.

Add	0.04547	0.05305	0.06366	0.07958	0.09947	0.10610	0.11937	0.13926	0.15915	0.17905	0.19894	0.21884	0.23873	0.25863	0.27852	0.31831	0.35810	0.39789	0.47746	0.55704	0.63662	Add.
D. of space bel. P. L.	0.05262	0.06139	0.07366	0.09208	0.11510	0.12277	0.13812	0.16114	0.18415	0.20717	0.23019	0.25321	0.27623	0.29925	0.32227	0.36831	0.41435	0.46039	0.55246	0.64454	0.73662	D. of space bel. P. L.
W. D	0.09809	0.11444	0.13732	0.17166	0.21457	0.22887	0.25748	0.30040	0.34331	0.38622	0.42914	0.47205	0.51496	0.55788	0.60079	0.68662	0.77245	0.85827	1.02993	1.20158	1.37324	W. D.

Pitch Diameters of Gears When Circular Pitch Is Given (*Continued*)

The Outside Diameter of a Gear Whose Addendum Is Standard Is the Same as the Pitch Diameter of a Gear Having Two More Teeth.

The Annealing of Steel

By C. M. Johnson

Why steel is annealed and the results obtained with pipe and open-fire annealing. Surface decarbonization and means adopted to overcome it. The necessity of uniform heat and the temperatures at which steel is best annealed. Quick and slow annealing. The effect of overheating and alloying materials and the formation of graphitic carbon. Why annealed steel is soft.

The first consideration of this subject should be as to why we anneal steel. Manufacturers who turn or cut steel into various patterns and have a great many kinds and grades of steel to shape, are anxious to have their cutters remain sharp for the longest possible time. If they find that their tools are dulling rapidly they complain that the steel is too hard and use another steel that machines more easily and yet hardens sufficiently for their purpose. Well annealed steel being of uniform grain and free of internal strains, is in the best possible condition for hardening.

All cast steel, whether it be in the raw or forged state, gets a certain amount of incidental air hardening. The degree of this hardness, if it be raw steel, depends on the composition of the steel and the size of the mold into which it has been cast; if it be rolled or hammered, it depends on its composition and the heat at which it has been worked.

Other things being equal, the higher the heat at which steel is worked the greater will be its air hardness. Added to this, the higher-carbon plain steels have a denser structure in the unannealed state. In the alloy steels, particularly the chrome-tungsten and chromium steels, this glassy condition is still more pronounced.

This, either natural or acquired, semi-hardness would be ruinous to cutting tools unless it be removed by perfect annealing. Steel once annealed will remain so indefinitely unless it be heated again above the proper annealing temperature.

Annealing in Pipes

There are several forms of annealing; for instance, open-fire annealing, and annealing in pipes. The annealing pipe used in steel mills is from 6 to 8 inches in diameter, and one end is welded permanently shut.

The bars to be annealed are put in at the other end, together with as much charcoal as can be held, and the pipe is then closed up as tight as possible with fire clay, fire brick, and a circular plate, in order to prevent any air from getting in. Near this end there is a small vent hole, probably one-half inch in diameter, through which the steam from the charcoal escapes, as do also large quantities of carbon monoxide formed by the union of the hot charcoal with the air in its pores. The carbon monoxide is generated in such quantities that if it were not for the vent-hole the pipe would blow up.

The pipes are rolled into the annealing furnace; the chamber of which is about 9x14 feet. It is 36 inches high at the rear, with a sloping roof that is but 16 inches high at the door, the door being about 14 feet wide. The doors move up and down and there are peepholes to observe the heat.

Recarbonizing the Surface

One reason for packing in charcoal is to aid in removing the scale or black appearance and leave the bar with a clean metallic surface. Another reason is to add enough carbon to minimize the reverse operation or slight decarbonization that takes place.

Coarse crystals form in steels annealed in pipes, which means that the steel has lost in carbon and consequently will not harden file-proof on the surface. It is clear that a drill made from such steel will wear off, on the outer cutting edges, thus destroying its efficiency. For a great many purposes this surface decarbonization does no harm, as it is turned off anyway in the further process of manufacture.

The flame in the furnace burns with some smoke, which is desirable in all annealing. The smoky flame in open fire annealing prevents heavy scale from forming on the steel and avoids surface decarbonization. The heat looks rather dull red in color.

Open-fire annealing is particularly adapted to annealing of drill rods for twist drills and all steel on which even the slightest decarbonization must be avoided. Objection is made to decarbonization even when it is so slight that it can only be seen with a magnifying glass.

Uniform Heat

Uniformity of heat in the annealing furnace is essential. After steel has been perfectly annealed it will lose its softness as soon as the heat passes into the hardening range. An hour's overheating will undo the work of all the heating, in the proper range, that may have preceded.

A perfectly annealed piece of steel, if heated to from 1380 to 1550 degrees Fahrenheit, and laid down to cool in the open air will be nearly as hard as when it came from the rolls or hammers, and thus hard to machine. It is, therefore, necessary to have the heat uniform, or one end of a long bar may be perfectly annealed and the other end air hard.

The red-hot pipes, while still in the annealing heat, are rolled into a cooling-off furnace, that is a box of fire brick so made as to prevent a radiation of the heat. It requires about 36 hours from the time the steel is put into the pipe until it is taken out of the cooling-off furnace, at a temperature cool enough to handle.

The actual time required to anneal the steel is probably not over eight hours. If crystallization is favorable, less time than that would be required; that is, if the steel has not been excessively heated and, therefore, greatly coarsened in grain, before it reached the annealer.

To illustrate: the finest-grained steel is hardened steel. If steel is heated up to the hardening range of temperature and then quenched in water or oil we catch the grain in fine condition and that steel can be perfectly annealed in one-half an hour. Quenching prior to annealing, however, is not practical on a large scale.

Annealing Temperatures

All kinds of plain carbon cast steel that have never been reheated, such as ingots direct from the molds, should first be brought to a temperature of from 1470 to 1560 degrees Fahrenheit and held there for about one hour. In ordinary steel as it comes from the ingot, and particularly in high-carbon steel, the grain is very coarse.

To break up this coarse grain and give the steel a fine structure it must be heated above its critical temperature into the hardening range, and held there for a time. Then when annealed we can get the desired results.

On the other hand, we can take that same piece of raw cast steel and not heat it above the hardening range and its grain will be practically as coarse as it was before putting it in the annealing furnace.

Quick Annealing

After heating plain carbon steels of all kinds, to form 1470 to 1560 degrees Fahrenheit, and holding there for one hour,

the heat should be lowered as quickly as possible to from 1300 to 1330 degrees Fahrenheit and held at that temperature for from 10 to 12 hours. This might be called the ideal temperature for rapid annealing. The pipes can then be drawn and the steel cooled as quickly, or as slowly as desired. If the steel is perfectly annealed it can be withdrawn from the furnace at the annealing heat and thrown into water and it will remain soft.

A test of this kind was made by taking two pieces of steel from the same saw plate and, with one lying on top of the other, heating them until both were perfectly annealed. One was then thrown into a bucket of water, while still at the annealing heat, and the other was cooled in the air. Both pieces were then tested as to tensile strength, elongation, etc., and registered practically the same.

Slow Annealing

Rapid cooling of perfectly annealed steel has no effect whatever on its softness and this can only be impaired by heating it above the annealing range.

However, if the annealer has lowered the heat before the steel has been entirely annealed, or in other words, has not held it long enough within the range of temperature where that particular steel anneals most quickly, he stands a better chance of getting the steel eventually soft by cooling it slowly in lime or some other non-conductor of heat. He thus in reality holds it longer within the range of temperature where steel anneals slowly.

Steel will anneal at lower heats, but it will do so more slowly, the range of slow annealing being the temperatures below 1330 degree Fahrenheit, but if we let it cool very slowly we will thus accomplish the same work, but in a longer time.

Alloyed Steels

Plain carbon steels, no matter whether the carbon be 0.50 per cent. or 1.40 per cent., anneal best between 1290 and 1330 degrees Fahrenheit. This is also true of most chrome-tungsten and chrome-molybdenum steels and is particularly noticeable in high-speed steel, for it can be easily drilled after annealing it for three hours at 1330 degrees Fahrenheit, whereas it will require two or three times that length of time to accomplish the same softening at lower ranges.

A very high manganese or nickel content lowers the annealing heat in some steels as much as 480 degrees Fahrenheit. In general, chromium raises the temperature of annealing and nickel and manganese lower it. For example, the writer has annealed 12.5 per cent. manganese steel so soft at 800-850 degrees Fahrenheit that pieces one inch thick were drilled clear through without the slightest difficulty when using a high-speed steel (Rex A A) drill. This has been done repeatedly in this laboratory. There is a remarkable change in the structure that comes by heat alone. Most of us might think that hammering or rolling is the cause of the change, but heat is the primary cause. In a "scalded" ingot there exists a peculiar, loosely adhering columnar arrangement consisting of long lines of coarse crystals. By simply heating it up to about 1470 degrees Fahrenheit and then annealing it for a specified time, the coarse crystals can be broken up and a fine-grained, soft piece of steel obtained which is almost as easy to drill as lead.

Effect of Overheating

Steel that has been reheated and rolled or hammered need not be heated above 1330 degrees Fahrenheit. If the furnace is heated to 1470 degrees Fahrenheit, and a lot of steel is charged into it, it will be brought to 1330 degrees very quickly by the large body of cold steel absorbing its surplus heat.

If steel ingots are allowed to lie in soaking pits or reheating furnaces for a considerable time, at temperatures approximating welding heats, the annealer's task will be greatly complicated. Such steel is much harder to bring into the annealed state, by reason of the very coarsely crystalline structure formed by the excessive heat.

Bad cases of overheating or prolonged soaking at high heats will require two or three times as long to anneal at the regular temperature. There seems to be nothing to do in such cases but to reanneal until the carbon is finally brought again into the perfectly annealed condition.

Graphitic Carbon

While graphitic carbon is liable to form in any steel improperly heated and cooled, cold-rolled steel is most subject to this difficulty. In cold rolling the steel is worked and repeatedly reheated within the range of temperature where graphite forms rapidly. That is, it has had a series of anneals between 1200 and 1300 degrees Fahrenheit.

The longer annealing is continued at any annealing temperature the more graphite will be formed. At some temperatures it will come quickly and at others it will come slowly, but eventually.

The high percentages of carbon yield the black fracture most quickly; above 1.20 per cent. carbon being the most favorable. Under 1.00 per cent. of carbon steels are doubtless free from any appreciable amounts of graphitic carbon, at least under any conditions likely to be met with in practice.

The temperatures most favorable to the quick formation of graphite are between 1200 and 1300 degrees Fahrenheit. The least favorable temperature for its formation is below 1100 degrees. Above 1330 degrees Fahrenheit is also unfavorable to its formation, but scaling goes on very fast.

Steel containing chromium is not likely to contain graphite even with carbon as high as 1.27 per cent. and chromium as low as 0.6 per cent. I succeeded in starting a graphitic formation in such a steel only by heating it to from 1650 to 1830 degrees Fahrenheit for an hour or two before annealing at from 1200 to 1300 degrees Fahrenheit. In neither this instance nor in the case of the 1.04 carbon steel did there seem to be any appreciable tendency for a gradual growth of the graphite due to prolonged annealing.

Why Annealed Steel Is Soft

In ordinary language, steel is soft because, when heated to the temperatures mentioned above, it has the component grains more loosely combined, that is, the particles of steel are not lying so closely together as in the unannealed state. The result is that any tool that is working on this looser structure can get in between the grains, as it were, and pry off pieces of the steel.

The chemical explanation is, that the carbide of iron is no longer in combination with the pure iron or ferrite. The particles of iron carbide and those of pure iron are lying side by side, divorced by the prolonged heating at temperatures below the hardening heat.

A grain of iron carbide and another of pure iron, lying side by side, can be quickly re-united by heating to within the hardening range. Annealing breaks up that union, but they still lie so close together that they can easily be united again by heating the steel above 1380 degrees Fahrenheit, and then quenching it as quickly as possible in oil, or water, or lead.

The annealed condition is the direct opposite of that which exists when steel is hardened. The hardened particles of iron carbide and the pure iron are wedded together so thoroughly that a substance of a flinty nature, is born of this union, which is called hardened steel.

To sum up, there is no longer any mystery as to why steel softens, nor as to why it hardens. It is hard when the pure iron and the iron carbide it contains are entirely combined with each other. It is soft when the pure iron and the iron carbide are entirely separated from each other. Of course the distance between particles is microscopic; high heat combines them, and low heat separates them.

Here is the Calcutta idea of a skyscraper as told by *Indian Engineering*.

Pretty Colombo, which, in the past, was content with its one-storied, wood verandahed bungalow buildings, is fast following the fashion for the skyscraper, and Messrs. Delmege Forsyth and Company are getting put up for them a *six-storeyed* structure.

Unusual Pattern Making and Molding

Editorial Correspondence

The pattern and core boxes, with their numerous loose pieces, that are used for making Brown & Sharpe Manufacturing Company's automatic screw machine beds. The molding of the pattern in a mold composed of nowel, cheek and drag flasks.

The extremely irregular shape given the bed of the No. 00 automatic screw machine manufactured by Brown & Sharpe Manufacturing Company, Providence, R. I., makes the making of the pattern and core boxes, as well as its molding, rather an interesting job.

In Fig. 1 is shown the complete pattern as it is ready for molding, while Fig. 2 shows the numerous loose pieces that go to make up the complete pattern shown in Fig. 1. The pattern proper is built up on a large covering core print.

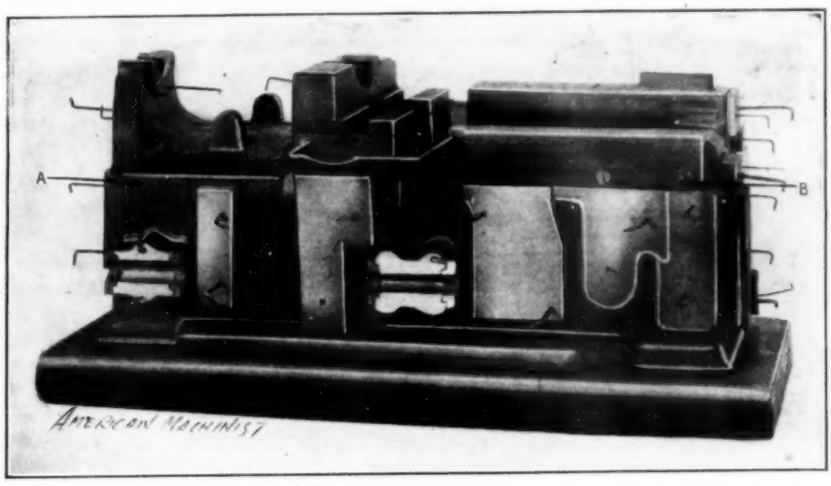


FIG. 1. PATTERN FOR AUTOMATIC SCREW MACHINE BED

On this it is fastened loosely with pins, so that the covering-core print can first be drawn from the mold and afterward the pattern.

THE NOWEL

The pattern is parted on the line *A B* and that part above this line is molded in the drag or nowel of the mold. This part of the pattern is made to the exact shape that is desired in the casting and hence it only has to be rammed up in the flask and withdrawn. After the main part of this section of the pattern has been withdrawn the loose pieces are picked out.

This leaves the drag of the mold as shown in Fig. 3 except that the tall upright core in the center has been placed in position. The drag, as here shown, is ready to receive the cheek flask of the mold. On both sides of the line *A B*, the outer edge of the pattern has been lined with sheet metal to prevent it from wearing out quicker than the other parts of the pattern. The main body of the pattern is made of wood, while the loose pieces and edges that are liable to wear are made of aluminum or other metals.

FIG. 2. THE VARIOUS PIECES THAT MAKE UP THE PATTERN IN FIG. 1

THE CHEEK

From the line *A B* to the bottom of the covering core, as shown in Fig. 1, the pattern is molded in the cheek of the flask. This part of the pattern proper is made in a rectangular-box shape as shown at *C*, Fig. 2. Numerous loose pieces are then added to it to form the bearing boxes, bosses, core prints, etc. The outer edge of the pattern, where it fits onto the covering core print, is also lined with sheet metal to prevent the corner from quickly wearing away.

When this part has been molded, the pattern and loose pieces drawn, and the small side cores located, it leaves the cheek of the mold as shown in Fig. 4. This part of the mold is now ready to close down over the drag of the mold shown in Fig. 3.

MAIN CORE BOX

The core box for the main core, with its loose pieces all in position, is shown in Fig. 5, while the box with its numerous loose pieces disassembled is shown in Fig. 6. This box, like the pattern, is built up in wood and the edges that wear, like the top edge where the sand is struck off, are lined with sheet metal. The numerous loose pieces are also made of aluminum like those on the pattern.

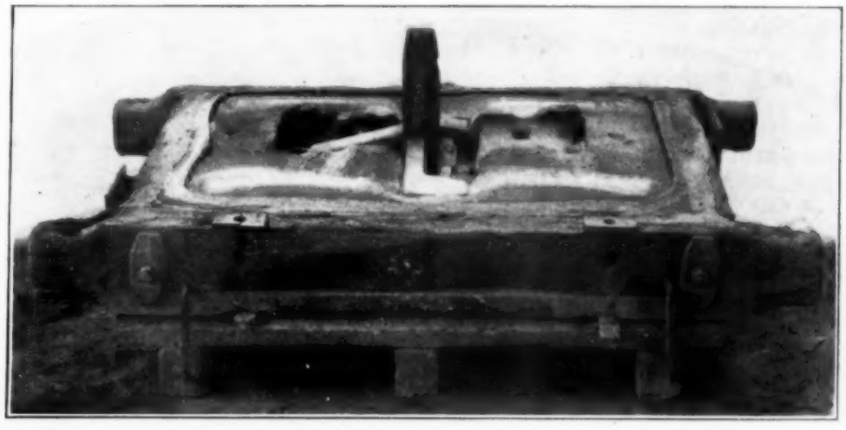


FIG. 3. THE COMPLETED DRAG OF THE MOLD

When the core is rammed up in this box it is dumped onto an iron plate and the loose pieces are picked out of the sand. This leaves the core in two parts as

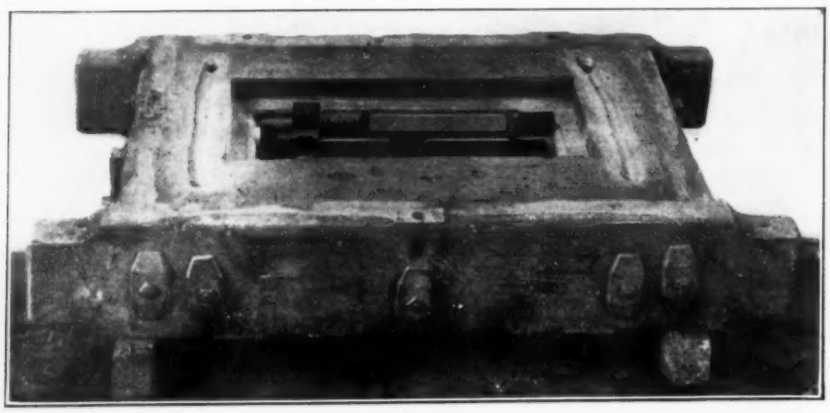


FIG. 4. CHEEK OF MOLD WITH SIDE CORES IN POSITION

shown at *D* and *E* in Fig. 7. These two half cores are then put in the oven to dry, and afterward blocked. They are then ready to lower into the mold, their flat bottom fitting into the impression left by the covering-core print, in the top of the cheek flask, as shown in Fig. 4.

FINAL OPERATIONS

The smaller cores that are used in the making of this casting, as well as the main core in two pieces, are shown in Fig. 7. These are so simple it is hardly necessary to show the core boxes. The next operation is to lower the two parts of the main core into their core prints in the cheek. A flat cope is then struck off and placed on the top of the cheek, and the mold is closed ready to pour, as shown in Fig. 8.

A great deal of time and care is taken in making these molds and in mixing and melting iron, so that first-class castings can be obtained. This is very essential, as numerous places on all sides of the casting are machined, and these must have a good, clean appearance, and show a close grained iron. The right and left-hand side of the casting as it is taken from the mold is shown in Fig. 9, with the risers, sprues, gates, fins, etc., removed.

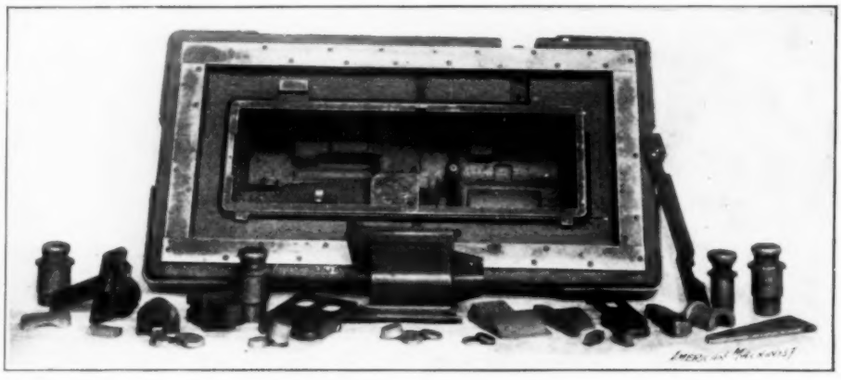


FIG. 6. VARIOUS PIECES THAT MAKE UP THE MAIN CORE BOX

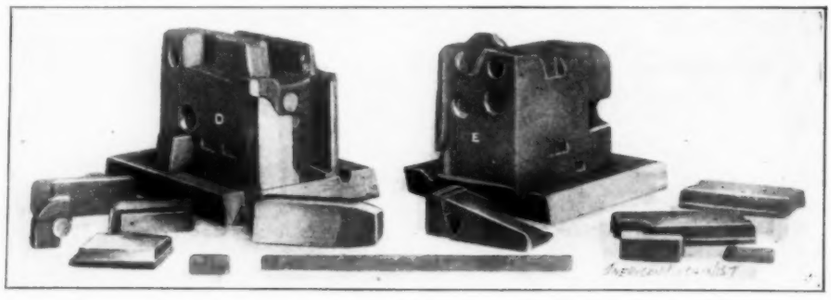


FIG. 7. ALL THE CORES USED IN MAKING THE MOLD

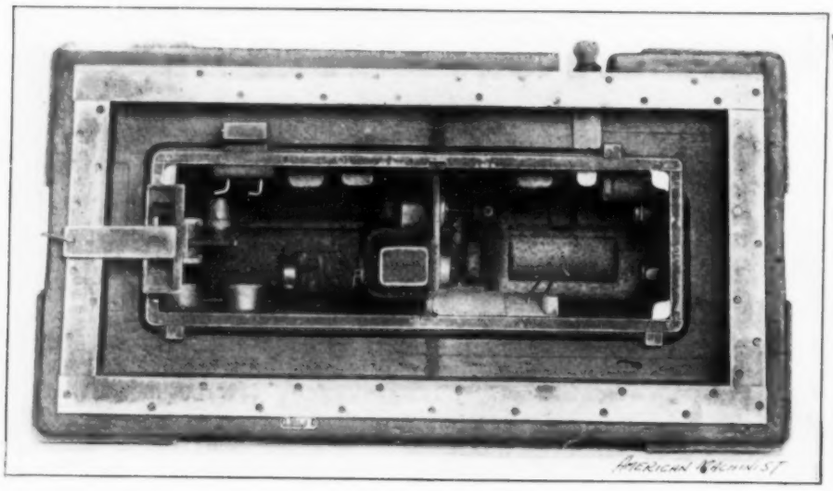


FIG. 5. COMPLETE MAIN CORE BOX FOR SCREW MACHINE BED

Report of the Patent Commissioner

The report of Edward B. Moore, Commissioner of Patents, which has just been published, contains a number of features which may interest those who have to do in any way with the Patent Office. The number of United States patents granted up to the time of issuing the report was 954,966, the average per year being between 35,000 and 40,000. The foreign patents granted by all countries number over 2,000,000. The Scientific Library contains between 40,000 and 50,000 volumes of reference material which is used in the examination of applications for patents.

Negotiations are now pending between the United States and foreign countries toward the elimination of the so called

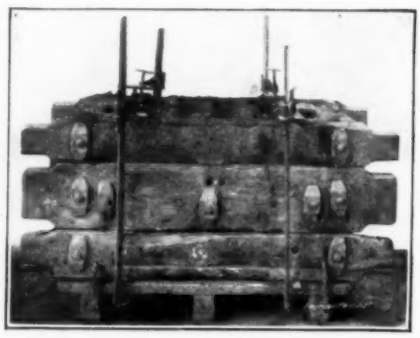


FIG. 8. MOLD READY TO POUR

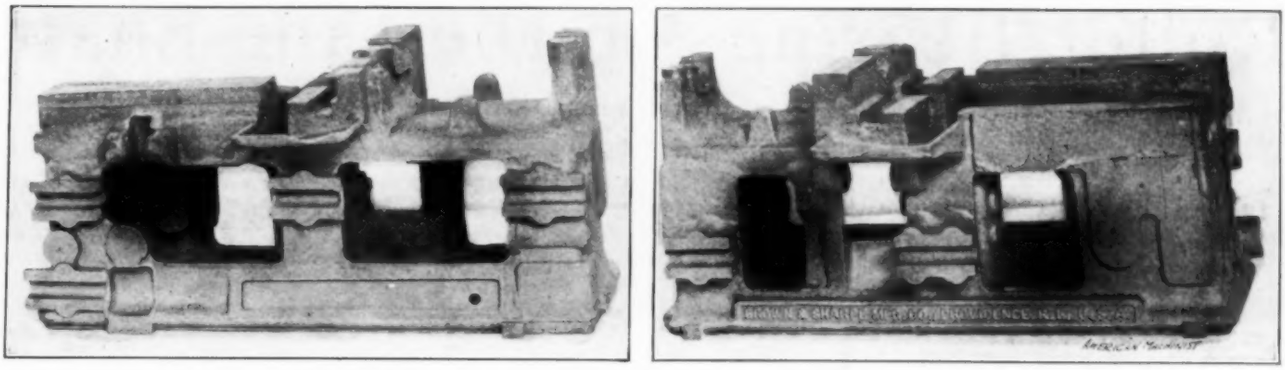


FIG. 9. FRONT AND REAR VIEW OF CASTING AS IT LEAVES THE MOLD

"working clause" in all patent laws. This means that it will not be necessary for a patented article to be manufactured in the country in which the patent is obtained, in order to keep it in force.

CUTTING OUT ONE APPEAL

The commissioner recommends the elimination of one of the three appeals now allowed by law to applicants for patents and to parties in interference cases, believing that this would injure no one and would materially reduce the time and expense of securing the final decision.

He advocates the establishment of a patent bar, so that only patent attorneys who have passed an examination may practise before the United States Patent Office. He further recommends the filing of two photographs of the drawings as a part of the application for a patent. He believes that this requirement is necessary in order to prevent, or rather to detect, any unauthorized tampering with the application after it has been filed.

DOING AWAY WITH THE CAVEAT

The repeal of Section 4902 which provides for the filing of caveats in the Patent Office is recommended. A caveat is effective for one year at a fee of $10, but the commission holds that this affords no real protection to the inventor. It merely insures notice being given to the one filing the caveat of the filing of an application for a patent by another for the same invention during the life of the caveat.

It is believed that, as the application for a patent and the payment of the first fee only costs $15 and insures the inventor of all the benefits received under the caveat, in addition to the fact that he is placed in interference with any patent not granted more than two years prior, and with any other application for patent which may be on file in the office, or which may be filed thereafter, that the additional protection is worth more than the difference in cost.

COURT OF PATENT APPEAL

He upholds the efforts of the American Bar Association to establish a Court of Patent Appeal, so that the final decision on any patent case shall not be rendered by the Circuit Court of Appeals of any particular section. He points out that there have been in the past numerous decisions rendered by different Circuit Courts of Appeals, which are directly opposed to each other and points out that the only logical way is to have one court of patent appeals, whose decisions will control the status of the patent throughout the whole country.

NEW BUILDING NEEDED

He ends by inviting the attention of Congress to the need of new and more commodious quarters for housing the Patent Office, its present building being entirely inadequate. The volume of business of the Patent Office increases each year, and as it has been more than self-supporting since its creation, there seems to be good reason for his request. As it is self-supporting, the entire cost of the Patent Office comes entirely from the inventors and not a dollar from the general tax revenues of the country. Anything, therefore, that can be done to expedite the examination and granting of patents would seem a very reasonable request.

The Proper Selection of Motors

The following summary of the characteristics of the various style motors by the Triumph Electric Company, may be of use and interest to those contemplating the use of motors.

Shunt-wound motors maintain a practically constant speed regardless of the load. They are used when constant speed is required under changing load conditions, and are particularly suitable for driving line shafting or groups of machines operated by one motor.

Series-wound motors vary in speed in proportion to the load carried. They exert a very strong starting torque and will race if allowed to run free. This type of motor is particularly suitable for operating cranes, hoists, turntables, etc., when frequent reversals of rotation are necessary and when the speed of the motor is constantly under the control of an operator.

Very satisfactory results can also be obtained from a series-wound motor when directly connected to some known definite load, such as a fan or blower under free circulation.

Compound-wound motors combine to some extent the advantages of the shunt- and series-wound motors. They will vary in speed with changing load conditions more than a shunt-wound motor, but will not race or slow down under a heavy load to such an extent as a series-wound motor. They are, therefore, well adapted for driving machine tools, printing presses, pumps, etc., when fairly steady speed and good starting torque are required.

The percentage of shunt and series winding in a compound-wound motor must necessarily be determined to some extent by the nature of the work to be performed. Generally speaking, a motor with 20 per cent. of the magnetizing force in the series turns, gives excellent results.

Here is a choice bit of mechanical knowledge from the *New York Times* in describing an accident to the steamer "Mary Powell":

"The crosshead which fastens the piston head to the slides in which it moves broke, disabling the machinery but causing no other damage."

We don't blame the reporter, but it seems as though someone in the office ought to have some idea of an engine.

Roller Bearings in the Line Shaft

By John A. Schroeder *

It is claimed that roller bearings in the line shaft will cut the friction of babbitted bearings in half, thus reducing the total power bill by from 10 to 20 per cent, and this saving increases with the increase of load.

Special requirements of line shaft bearings.

*Mechanical engineer Royersford Foundry and Machine Company, Philadelphia, Penn.

One of the main causes of waste of power in a manufacturing plant lies in the transmission of power through line shafting, caused by the friction in the bearings. In all other departments vast improvements have been made, tending to effect savings and thus reduce the manufacturing cost. The means for transmitting power through the plant, however, where line shafting is used, are virtually the same today that they have been for years; shafting is still running in babbitted bearings and the only improvements in this line have consisted in introducing various devices for oiling the bearings.

A few years ago there was a tendency to abolish line shafting entirely, running all machines by individual motors. It has been found, however, that unless the machines thus driven are run only intermittently or each machine requires quite an amount of power, the low efficiency of small motors, together with the high cost of the great number of them, with wiring, starting devices, etc., render this system uneconomical. It is generally conceded that the most economical transmission of power is by what is termed "grouped drives." A number of machines are run from one motor, through one or more line shafts.

There is always a great deal of friction where shafting is run in babbitted bearings, even where the shaft is perfectly alined. In most manufacturing plants, through the settling of buildings, the loosening of set screws, and the springing of the shafts, this friction load is increased greatly, and the time has come when the manufacturer is asking himself if there is no way or means by which he can reduce his friction load.

In machinery of all kinds ball and roller bearings have been introduced and their extensive use clearly demonstrates the saving they effect. Of the two, the ball bearing, presenting only point contact, is the most efficient and should be used wherever possible. Under heavy and varying loads, however, and in places where bearings must be split, the roller bearing is more successful.

When the question arises as how to reduce the friction load in a manufacturing plant, attention naturally is turned to ball and roller bearings, and manufacturers of transmission machinery have lately given this matter a great deal of attention. Ball bearings of several makes, designed for line-shaft purposes, have been on the market for some time. It is, however, impracticable to split a ball race, and a line-shaft bearing should necessarily be split, in order to be practicable. The attention therefore turns to roller bearings, and some roller bearings successfully used on special machinery and in special places have been applied to line shafts. In some cases they have given satisfaction; in many others not, from the fact that in applying these roller bearings to this service the necessity of changing the construction was not taken into consideration. Recently roller bearings, constructed especially for line-shafting service, in the construction of which care has been taken to meet all requirements to be encountered in such service, have been placed upon the market, and will fill a long felt need and demand.

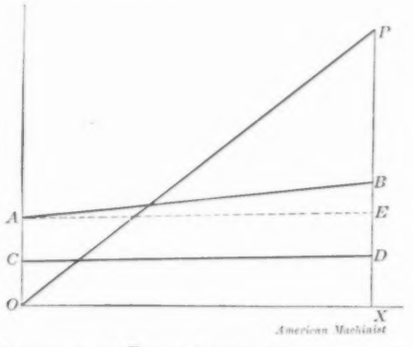


DIAGRAM OF TOTAL POWER REQUIRED AND INCREASE OF FRICTION WITH LOAD

The conditions and requirements peculiar to line shafting service are as follows:

Soft steel in the shafts.

More or less end play.

More or less springing in the shaft.

A commercial cold-rolled, cold-drawn or turned shaft is made from a low-carbon, therefore soft steel, and if hard rollers are run directly on this, it will soon be worn into. A high-carbon steel bushing should, therefore, be provided, securely clamped to the shaft, so as to present a hard wearing surface for the rollers to revolve upon and to provide an absolute protection to the shaft.

In most roller bearings the rollers or roller structures have been revolved between stationary ends of the bearing boxes. If applied to line shaft, the end play existing will force the rollers or roller structures against the stationary ends, causing friction and wear. In a roller bearing intended for line-shaft service, the roller structures should, therefore, be of the floating type, absolutely free and clear, and no revolving part should be allowed to run against any stationary part.

The belt on either side of line-shaft bearings will often cause the shaft to spring more or less, this springing causing the shaft to bend in the center of the bearing. If the rollers are run loose in the box, this bending of the shaft may cause them to get out of alinement, to bend and to bind. A properly constructed roller bearing for line-shaft service should, therefore, have the roller alined so as to be kept at all times parallel with one another and with the shaft. In a roller bearing for any class of service, the shorter the rollers are the more efficient is the bearing. The question then arises, how long should the rollers be in order to make the bearing most efficient, consistent with required strength. If a roller is alined so that it is at all times kept parallel with the shaft, it cannot be subjected to anything but an absolute crushing strain. It should, therefore, be of sufficient diameter and sufficient length to withstand a crushing strain equal to, or somewhat above the shearing strain of the shaft. If such is the construction, a roller cannot break unless there should be a flaw in the steel from which it is made.

Consideration must be given to the wear of the bearing. The bearing should be so constructed that the wear be allowed to come on such parts that can be most cheaply and readily replaced. If the rollers are made of a high-grade, high-carbon steel and they are case hardened and ground, they will show very little, or no wear, running against surfaces of softer material. It is a well known fact that steel running against cast iron gives as efficient results in regard to nonwear, as any two metals. If the box itself is made of a good grade of cast iron, there will be very little wear on the box itself. The bushing which protects the shaft is necessarily thin, and could not be made of cast iron. It should, therefore be made of a high-carbon steel, but not case hardened, so that the wear will come on this bushing and none on the rollers. The bushing, naturally, can be cheaply and easily replaced.

The friction load in a manufacturing plant is the power required to run the shafting with all machinery standing idle, in other words, with clutches thrown out, when such are used, or with belts running over loose pulleys, where tight and loose pulleys are used. It is very seldom that the friction load is less than 30 per cent. of the power load. Very often it runs 40 per cent. and above. With properly con-

structed roller bearings, properly installed, this friction load can be cut practically in half, which means a saving of from 10 per cent. to 20 per cent. of the total power used.

As load is thrown on the shafts, the friction in the babbitted bearings is increased, due to the increased pressure between shaft and bearing. The friction at full load, that is with all machines running, is, therefore, greater than at no load; viz., where babbitted bearings are used. Where shafts are equipped with roller bearings, however, there is but a very slight increase in friction, if any at all, with increased load, so that the total saving of power by the use of roller bearings in place of babbitted bearings is even greater than the saving in friction load alone. The accompanying diagram will clearly illustrate this.

Line *OP* represents the power required for driving the machinery; with no load at *O*, and full load at *P*. The friction load is represented by line *A B*, with shafting equipped with babbitted bearings, and by line *C D* when equipped with roller bearings. At no load, the power required to drive shafting, the friction load, with babbitted bearings is *A Q;* with roller bearings *C O*. As load is thrown on, the friction in the babbitted boxes increase until at full load it is *B X; P B* being the power actually used for driving the machinery. With roller bearings the friction increases very slightly, if at all, with increased load, so that the friction at full load, *D X*, is about the same as *C O* at no load. The saving in so called "friction load" is *A C;* the saving in power at full load is *B D*. Drawing *A E* parallel with *C D*, *B E* is the additional saving in power at full load. The total power required to drive machinery and shafting, with babbitted bearings is *P X;* with roller bearings *P X* less *B D*.

In every manufacturing plant, records should be kept of the power used as well as of the friction load. At regular intervals indicator diagrams should be taken from the engine, or readings of the motors, with friction load only, as well as with full load. If either is found excessive, it should be reduced and kept reduced. The line shafting should be kept properly alined and whenever possible, roller bearings should be used. No better investment can be made than substituting roller bearings for the babbitted bearings, if thereby a saving can be effected of from 10 per cent. to 20 per cent. of the total power used, the net result of lessening the friction load by one-half. A saving of 10 per cent. in the total power will, as a rule, pay for the cost of substitution in a year's time or less.

It must be remembered that roller bearings should not be used indiscriminately. When line shafting is run at unusually nigh speeds, or when the load is in the nature of shocks, such as in a forge shop, where drop hammers are used, they are unsuitable. The continual shocks, reverting back to the rollers, will gradually crystalize these until they finally break.

About the Iron Industries of Japan

By A. Gwaikokuijin

A brief outline of the iron industry in Japan, showing its growth during the past forty-three years and a query as to its future.

In the matter of iron industries, Japan stands in need of vast improvement. If one has ever inspected any of the great iron works in the United States, and noted the capacity for output, as well as the skill of the workmen, then considered the immense disadvantage that Japan will have to labor under for want of iron ore, he would think, in place of her attempting to complete with foreign countries which have raw material ready at hand, that it would be much cheaper for Japan if she were to import the manufactured iron from the United States or Great Britain.

Among the iron foundries that have been established during the Meiji era (the past 43 years), the Kamaishi iron foundry and the Yawota foundry are the two largest, the former being a private company, while the latter was established by the Department of Agriculture and Commerce. The former had suspended its work for some years, but resumed it a few years ago. The Yawota foundry was established first, with a capital of 4,000,000 yen. (At present exchange, one yen equals 49⅝ cents United States gold.) The amount of its capital has been increased until it now stands at 30,000,000 yen and it is at the present time the largest iron foundry in the country.

Besides these two foundries, there is the Naval steel foundry at Kura, Nippon steel foundry and the Hokkaido Colliery and S.S. Company's iron foundry at Muroran. The Nippon iron foundry, which was established in 1906, laid on its smelting furnaces at Aomori and Fukushima, using charcoal as fuel, but neither of them proved to be successful on account of the expense of fuel.

The greatest producer of pig iron is the Yawota iron foundry, where this kind of iron is turned out to the amount of about 100,000 tons a year. Besides, pig iron is also produced at the Muroran steel foundry, Sumitonu iron foundry and the Osaka military arsenal. The whole amount of pig iron made in Japan is less than 150,000 tons per year. Japan produces no rolled iron to speak of, it being wholly imported from abroad. Steel is produced in the Yawota iron foundry also in those of Kure and Muroran, the former being engaged mostly in such steel work as plate rails, wire, etc.

The steel produced at the Yawota iron foundry amounts to about 30,000 tons per year, while that of Kure and Muroran together reaches 100,000 tons per year, the total output reaching about 180,000 tons.

The amount of domestic products of both p.g iron and steel is estimated at less than 230,000 tons per year, whereas the amount of iron imported in one year is 100,000 tons of pig iron, 350,000 tons of iron bar and plate, and over 200,000 tons of wire, etc., besides which, iron materials imported for ship-building purposes will amount to about 600,000 tons per year, making the total amount of various kinds of iron imported into Japan in a year something over five times the amount of home product.

Japan producers its raw materials from mines at Kamaiski, Hokkaido, Korea and Manchuria. China has also a number of iron mines, and the minerals of the Taiya line contain 60 per cent. of iron, which is used as material in the Uawata foundry. As to the fuel for iron works, Japan has very little suitable for the purpose. The government regards pig iron as raw material and the present tariff tax imposed is 4 per cent. There is, however, some talk among some iron manufacturers of getting the government to count pig iron as a kind of manufactured article, so that a higher rate of tax can be levied, which they think will, without a doubt, help the development of iron works in Japan.

The British commercial attaché at Yokohama reports that it is proposed to set up Japanese government railway workshops at Oi, near Tokyo. The workshops, which should be completed by the end of 1912, are to be used for the repair of passenger coaches and freight cars, and the machinery at the present railway workshops at Shimbashi is to be transferred to Oi. It seems probable that the operations of the workshops at Oi will eventually extend to the manufacture of these vehicles.

Machine for Making Spiral Springs

By Frank S. Bunker

An interesting piece of apparatus comprising a set of feed rolls and a guide block for receiving the wire and for holding the spring to size as it is coiled and fed out of the chamber in the block in any length desired.

In many shops the method of winding spiral springs is to obtain a mandrel and after successive trials finally obtain the desired diameter and pitch at which to wind them on a lathe.

This method generally gives poor results, as the spring will open a little more in one case and a little less in another, owing principally to the difference in tension on the wire in winding; and the pitch will vary, owing to the variations in the set or twist given the wire as it is wound on the mandrel. If the coil of wire supplying the spring is allowed to uncoil suddenly, the spring being wound receives a length of wire with no set in it and the pitch changes.

For the proper winding of spiral springs, either compression or tension springs, the conditions must always remain the same to obtain uniform results.

In the accompanying sketches will be seen a set of rolls and spinning blocks

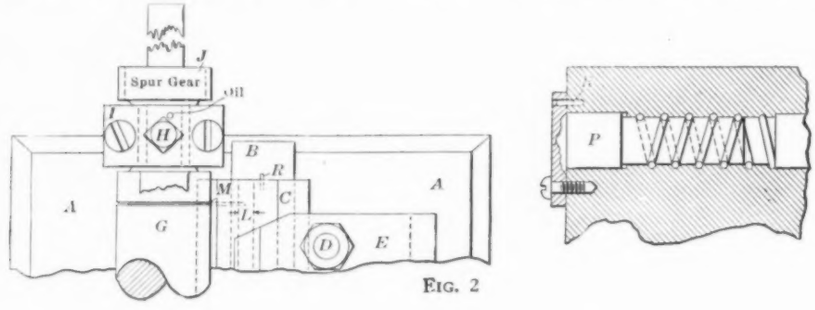


FIG. 2

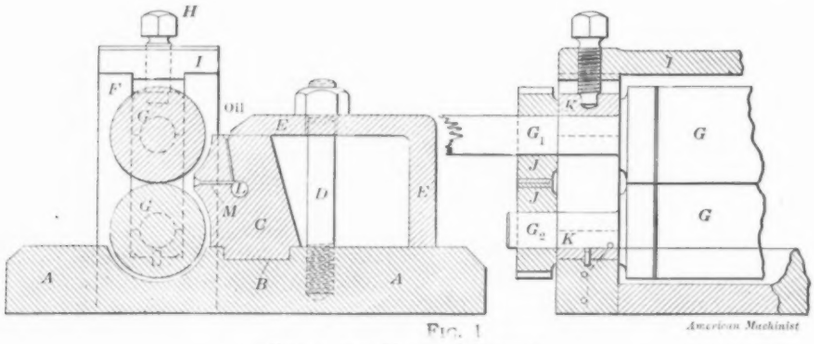


FIG. 1

ROLLS FOR MAKING SPRINGS

for making spiral springs in lengths as long as the wire will permit, which can afterward be cut off to the desired lengths.

The rolls make the small spiral springs so much used on metallic packing to hold the segments together and press them against the piston rod. The lengths of these springs vary with the size of the packing, but the diameter seldom changes, as with large packing two or more springs are used and with small packing a smaller number.

With this machine, springs can be turned out 30, 40 or even 50 feet long as easily as they can be wound two feet long on a mandrel.

General Description

The machine consists of a steel bedplate, two tool-steel rolls with their housings and bearings and adjusting screws together with spinning blocks for each and every size spring desired.

The base is made of a piece of heavy steel boiler plate about 1½ inches thick, and in this base is cut a groove in which the spinning blocks fit. Also a half-round groove is cut or milled with a radius about 1/16 inch greater than the radius of the roll to be used. In both sides of this base, at the ends of and central with this groove, slots should be cut to allow the housing posts to fit into place and be secured with countersunk-head machine screws.

These housings are also of steel, with a slot milled in them wide enough to allow the bearing of the rolls to be fitted in. The bearings are of bronze, of the "half type," and the bottom one in each housing is provided with a small steel dowel, while the top one has a counterbore with which fits the adusting screw *H*. These bearings are shown at *K K*, Fig. 1.

The Rolls

The rolls are of tool steel and hardened after finishing. They should be about 1¼ inches in diameter and the top roll neck G^1 should be left long on one end as a drive shaft for the rolls.

The ends of the shafts are fitted with spur gears which should be deep in mesh when the rolls are in contact, and the teeth should allow of some adjustment of the rolls.

The rolls have grooves cut around them of varying sizes to allow of different sizes of wire being inserted and should grip the wire firmly when the adjusting screws are fed or screwed down solidly on them. Remember, if these feed rolls slip they will wear a small groove in the wire and ruin this part of the spring, so care should be taken in making the grooves so that the rolls shall grip the wire tightly.

So much for a general description of the machine and rolls.

The Spinning Blocks

The spinning blocks are the most important part of the machine, and care and accuracy should be used in their making. Take a block of tool steel large enough to suit the purpose at hand and finish the bottom to fit snugly into groove *B*, Fig. 1, and after it is in place and clamped into position with clamp *E E*, lay off the guide hole *M* in block *C*. This hole should be 0.002 inch larger than the wire to be used, and the hole should be directly opposite the groove of the corresponding size in the rolls. Drill this guide hole to such a depth that it will be cut into when the hole *L* is drilled, countersinking it a little. This is the procedure for all classes of work in starting the blocks.

Now, if the spring to be wound is a closed pitch, or spring whose pitch is only the diameter of the wire used, proceed as follows: Carefully measure the outside diameter of the spring or sample and lay off a hole in the block *C*, Fig. 1, which, when drilled, will cut into the guide hole at right angles with it, and will have such a position that the guide hole will be exactly tangent to its circumference. The drill in drilling the guide hole must not go so deep as to mark the opposite side of the spinning hole *L*, or it will cause the point of the wire to catch and refuse to spin. The hole *L* is drilled clear through the block *C*, and a plug is fitted in which should come to the edges of the guide hole and thus leave open only one means of exit for the spring. Drill a small oil hole which will nearly meet the the junction of the guide hole and the spinning hole, and which should be provided with an open oil cup to feed oil on

the point of contact of the spring wire and the sides of the spinning hole. This is to prevent cutting of the block by the wire.

When the block is completed have it hardened as hard as fire, water and case-hardening materials can make a good grade of carbon tool steel. Before hardening make sure the hole *L* is perfectly smooth; if not, lap it so.

The Spinning Operation

Round or point the end of the wire to be used and after entering it through the rolls and guide hole and oiling up well, start the rolls in motion. The wire will enter and be forced to revolve or spin itself into a perfect spring, coming out of the hole *L* as fast as the rolls are driven.

As to driving the rolls: They can be operated either by a lathe, when the end of shaft *G* will be gripped by a universal chuck. They may be run by a motor or by a pneumatic air drill. I have used them in all these ways.

A board or run-way should be built to receive the springs and carry them as they emerge from the spinning block.

The spring, as it comes from the spinning block, will be found to be exactly the diameter of the hole it is spun in and will be wound close and tight, and may be run out to any desired length that the length of wire will permit.

For spinning compression springs, the same style of block is used with the changes indicated in Fig. 2.

The hole in the block is bored in a lathe. The diameter of the hole is the diameter of the springs minus the diameter of the wire to be used. A spiral groove of the required pitch is then cut in the bore with a tool having a round point the same size as the wire and a plug *P*, Fig. 2, fitted with a corresponding groove of like proportions cut in it. When the plug is fitted and held in place, a spiral, round track is thus left open for the wire to follow when forced through the guide hole.

This method of making springs assures uniform results and where large quantities of springs are used is very economical. The wire is given an initial and permanent set as it hits the spinning hole, which it is impossible to give it when winding it over a mandrel.

Rebuilding a Lathe Into a Plate Planer

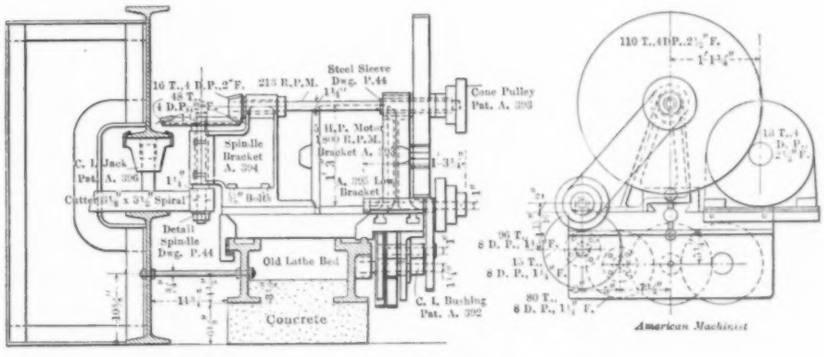
By John P. Faber

How an old 28-inch lathe was converted into a plate planer with an expenditure of but little time and money.

To rebuild an old lathe into a plate planer would seem at first sight to involve more work and expense than the construction of an entirely new machine, but in reality it is quite a simple undertaking.

The primary cause of this plate planer or more properly, plate miller, was the undertaking of some special work by the shop which required plates ¼ inch thick, 7 feet 6 inches wide and 18 feet long planed true on two and in some cases on all four edges.

As the work did not warrant the purchase of a new or even a second-hand plate planer, I hit upon the following scheme: An old 28-inch lathe with a 26-foot bed was secured at a low figure. The bed was cut into two pieces, 20 feet and 6 feet long, respectively. The shorter piece carried the headstock and this was



Rebuilding Lathe into Plate Planer

reserved for the boring mill later. The longer section and the carriage were utilized for the plate miller.

As will be seen from the line cut, the cutter is on a vertical spindle, journaled in a casting that is bolted to the cross slide of the lathe carriage. The cutter is driven through bevel gears by a horizontal shaft, one end of which is carried by the above mentioned casting on the cross slide. The other end of this horizontal shaft is driven by a feather key in a bushing through which it is free to slide lengthwise. The cutter can thus be fed up to work by the cross-feed screw, a 2-inch travel being all that is necessary.

The sleeve that drives the horizontal shaft revolves in a bearing attached to the body of the carriage. This sleeve carries a large cut gear that is driven by the motor pinion and also a cone pulley for the longitudinal feed.

The driving motor is 5 horsepower and is carried on the carriage as shown. A couple of extra gear reductions were added to those already in the apron, so that the feed is through the original rack and pinion and can be varied from 0.026 to 0.006 inch per revolution of the cutter. Power is brought to the motor by a flexible cable. At the end of the cut the carriage can be returned either by hand or by power by crossing the feed belt. The cutter is of 3¼ inches diameter, of Novo steel, making 71 revolutions per minute, which gives a surface speed of 65 feet per minute.

The lathe bed is bedded in concrete on the floor, in line with the clamps which consists of an upper and lower I-beam united by end framing and carrying five small movable screw jacks for clamping the plates as shown.

The plates to be milled are first punched to templet and then 10 or 12 are bolted together and machined at the same time. After one edge is milled, the the entire pile of plates is picked up and turned about by the crane to have the opposite edge finished, the bolts preventing any movement of the plates over one another.

While not as rapid as a regular plate planer, this machine is capable of good work, and on account of its small cost, can be used for intermittent work where it would not pay to invest in a more expensive machine. It is obvious that the length of cut on a machine of this sort is only limited by the length of bed obtainable, the operating mechanism being the same in all cases.

The following was overheard on a railroad train:

"See that pile of scrap iron over there. That used to be wasted but they are now using it instead of pig iron."

Letters from Practical Men

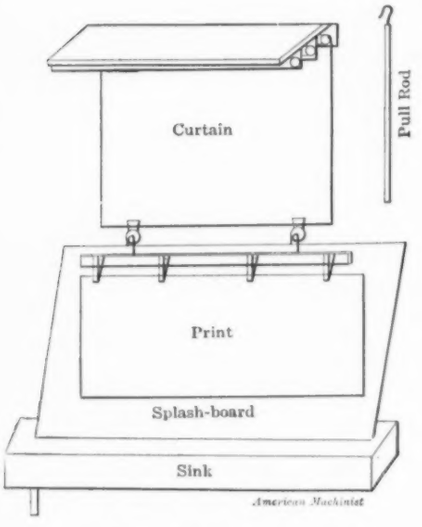
Drying Blueprints

While others may have conceived the same idea, the following method of washing and drying prints has proved very satisfactory to me.

Suspend a number of ordinary spring window shades over the sink as illustrated. Make as many strips of wood as required about ½ inch thick and 1¼ inches wide, as long as the longest print used. Two hooks fastened to the top of strips engage the same munber of rings or pulls on curtain. For 30x42-inch prints I have four spring clothespins screwed to the strip.

After printing, lay the print on the table and engage the clothespins with the print; then hang on curtain, which is, of course, pulled down. While washing with the small hose attached to the faucet, the print is held against the splashboard which drains in the sink.

After washing, raise the curtain with a rod made for that purpose. Several



DRYING BLUEPRINTS

curtains suspended above the splashboard and sink require little space and the same number of prints can be dried at the same time, and dripping on the sink and splashboard. With the use of these strips, prints may be handled either wet or dry without any inconvenience.

A 30-inch curtain will be suitable for any width print, as the hooks and rings can remain the same distance, irrespective of the length of strips. For exceedingly small prints, short strips with one hook only will be necessary.

S. J. S.

Lead, S. D.

Concerning the details of making things in machine shops, from the first sketch to the shipping room.

A letter good enough to print is good enough to pay for. The value is in the idea—not the length of the letter.

A Machine for Cutting Lubricating Grease to Size

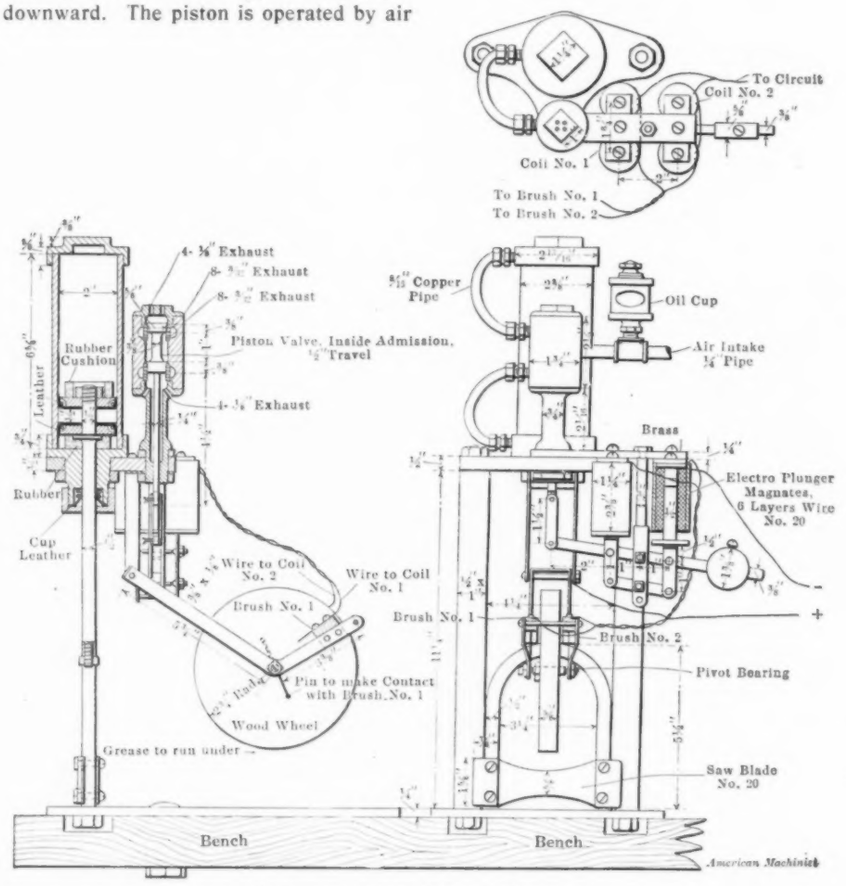
The line cut shows an electric cutter which we use to automatically cut the locomotive-rod cup grease to lengths of one pound each, ready for shipment. The knife or cutter is double acting; that is, it cuts when piston advances upward and also cuts when piston advances downward. The piston is operated by air from the piston valve, which is operated by a magnet which gets its power from the shop dynamo. As the pressed grease advances from the nozzle at the end of the grease press it advances under tne wood roller at the cutter, and on this wood roller are located contact points which revolve with the roiler and when they come in contact with brushes on the arms, the power is applied to the magnet which operates the piston valve, admitting air to the cylinder, which operates the cutter. This cutter is a great labor saver and was designed by machinist Oscar Jensen.

Clinton, Iowa. W. J. SHADLE.
Shop Foreman, C. & N. W. Ry.

To Prevent Taps Breaking

Heat the tap at the shank end of the thread to a blue color and it will eliminate this trouble, as the shank will twist to a certain degree before the tap breaks, thus warning the user.

GEORGE F. KUHNE.
East Rutherford, N. J.

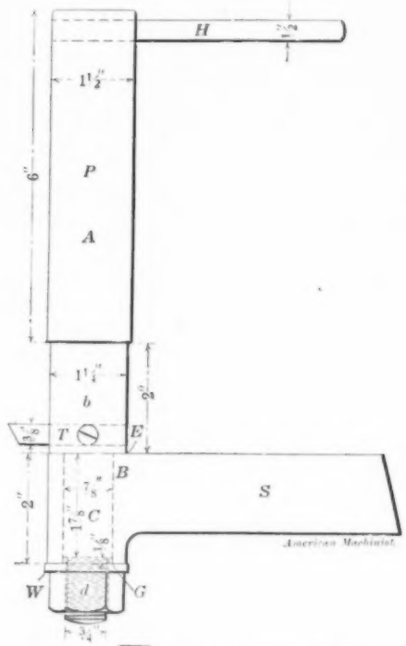


AUTOMATIC ROD GREASE CUTTER

Tool for Turning Concave Worm Wheel Faces

The shank *S* is either cast or forged and fits into the tool post of a lathe.

The part *C* is made a neat running fit in the ⅞-inch reamed hole in the shank *S*. The faces *G* and *E* are faced off. A ⅜-inch square hole is made for the



TOOL FOR TURNING CONCAVE WORM WHEEL FACES

tool *T*, about ¼ inch above the shoulder *E*. A 5/16-inch set screw clamps tool.

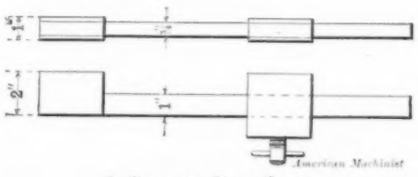
A ½-inch bar is driven into upper end of the spindle for a handle *H*. *W* is a fiber washer. The tool *T* is set to the proper radius and the cut started by feeding the tool into the blank a little and slowly turning the spindle with handle *H* until a small arc is cut in the blank; this is repeated until the proper throat diameter is obtained.

Baltimore, Md. F. E. FICK.

A Sliding Bar Gage

We use a shop gage of much value like the one illustrated. It is made entirely of drawn steel; this reduces the work on it to a minimum—squeezing the jaws, riveting on the side plates, and putting in a locking screw constitute the only work necessary to complete it.

Such gages are handy in almost any



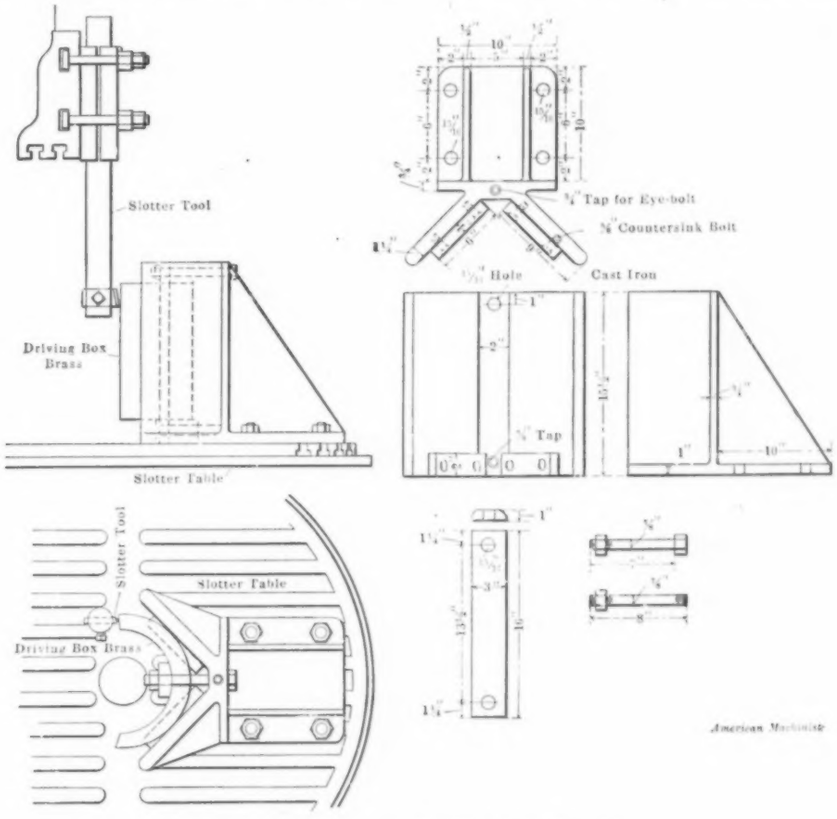
A SLIDING BAR GAGE

department of a manufacturing shop—grinding, milling, planing, lathe and screw machine. Of course, a male standard of some sort has to be used to set them and when once set, they are good for the closest work of which the operator is capable though withal they are rugged enough to stand a few falls to the floor and occasional sly service as hammers without material injury. Should a close adjustment be a desideratum, a supplementary sliding jaw fitted with a screw can be added.

Middletown, Conn. S. F. C.

Slotting Lug Fits on Driving Box Brasses

The accompanying line-cut shows a V-casting that is used on a slotter to slot



DEVICE FOR SLOTTING DRIVING-BOX BRASSES

the two lug fits on driving-box brasses, in place of placing them on a planer to plane, which is the usual practice.

What brought this method about was the fact that the slotter was more times idle than the planer and by bolting the V-block to the slotter table the lines on the brass can be adjusted by the table movements. Only one setting of the brass is required, which is simply to clamp it in the V-block.

When this work is done on a planer it has to be set twice, and any mechanic can readily see the advantage of this V-block for driving box brasses.

Clinton, Iowa. CHAS. MARKEL.

Heat Treatment of High Speed Steel

In looking over some articles in back numbers of the AMERICAN MACHINIST I was impressed with the different opinions and methods advocated by various writers, each one, no doubt, finding his methods the best for his particular work.

To get the best results from any good brand of high-speed steel should not be difficult. There are certain conditions that need to be observed in treating the metal, whether forging, annealing or hardening it. If ordinary care is taken in these, good results should certainly follow.

In the heat treatment of high speed, or any other steel, don't expect to get good results from cheap labor, as it pays to have a good man. Doubtless the best heat expert you can get, is the man who has been brought up at the forge, if he takes an intelligent interest in the advancement of his trade, and, by diligent reading of suitable publications, keeps himself abreast of the times.

HARDENING

In my experience the best hardening heat for high-speed steel varies a good deal with different brands of steel and ranges from 1950 to 2200 degrees Fahrenheit. The best heat for any brand can only be found by experiment.

A very good guide in heating is to

watch for the oily or greasy appearance that the steel assumes around 2000 degrees Fahrenheit. The proper heat might be just short of this point or just beyond it, but the point is a good guide to work from. In heating the tool bury it in the coke and watch the heat by easing up one piece with a light poker.

To prevent the tool from becoming pitted, more especially in its passage from the fire to the cooling bath, it can be coated with a borax composition. This is not so dense as silicate of soda, or similar fluxes, which are apt to leave soft spots, and it peels off readily when the tool is immersed in the bath. We use cottonseed oil in preference to a fish oil. I think it strikes much quicker and gives a harder tool.

ANNEALING

In the annealing of high-speed steel we have little trouble. We are fortunate in having at our disposal several carbonizing furnaces heated by producer gas; one of which is cooled down each week end.

On Saturday, after the last batch of boxes have been taken from the furnaces, about 9.00 a.m., we place the tools, to be annealed, in one of the boxes, without any packing, and put it into the furnace. The furnace is then maintained at a temperature of 1400 degrees Fahrenheit, until 12:30, when it is shut down. The box is allowed to remain in it until the following Sunday evening, when it is taken out and placed on the floor, by the fireman, previous to lighting up the furnaces. By Monday morning the annealed tools are thus found soft and ready for machining.

It is seldom that we are called upon to anneal high-speed steel in a hurry, but I have put steel into the furnace at 3:00 p.m., taken it out at 6:00 p.m., put it on top of the hot gas flue to cool gradually, and had a man machining it by 7:00 a.m. the next morning. It would, however, have been much softer had we left it to the week end.

I have tried the quick annealing method, advocated by C. U. Scott, on three separate cutters. His instructions were followed closely and the steel certainly was annealed, but not nearly as soft as we are in the habit of getting from our own methods.

PITTING

I have proved, conclusively, that we get good results from the above method of hardening. In one instance I had a tool hardened by one of the leading steelmakers in this country, and after working an hour and a half the edge was gone. They hardened another tool and it was no better. We hardened it again and it stood up all right.

Where the steelmaker went wrong was, in his anxiety to prevent the tool from being pitted he did not raise it to the proper hardening heat. I sent another tool to a prominent hardener to the trade and it was returned very hard but unfit for use owing to the surface being badly pitted.

Paisley, Scotland. THOS. K. POWRIE.

Economy in End Mills

An end mill seems to be about the next thing to a combination-center-drill for snapping off at unexpected moments.

To avoid the expense of annealing and recutting the end teeth, it is a good plan to have them made with a hole down the center, as shown in the line cut, so that they can be placed on the cutter grinder

ECONOMY IN END MILLS

and recut with the wheel. It not only saves time but also avoids the danger of bending in rehardening.

If the hole is made proportional there is no weakening, in fact, they are really much better this way, as many breakages are due to inadvertently taking a larger cut than the width of the tooth face. This leaves a solid piece of stock which jams at the center.

With this cutter the uncut stock would pass up the hole out of harm's way. The hole also serves to carry the oil which helps to keep the cutter cool. A loose center can be made to fit the hole for the first grinding.

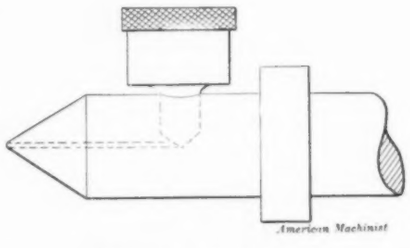
Middletown, Conn. J. H. B.

Dead Center with an Oil Cup

I recently saw a lathe center used on heavy work which had an unusual method of keeping it lubricated. The center had a small hole drilled in the end, far enough to meet a hole drilled down from the top which carried an oil cup that would hold quite a supply of oil.

This fed the oil directly into the center hole, and as the pressure of the cutting tool is almost sure to force the work away from the back side of the center to a greater or less degree, so that lubrication was positive without cutting any small grooves as is sometimes done.

Chicago, Ill. FRANK C. HUDSON.



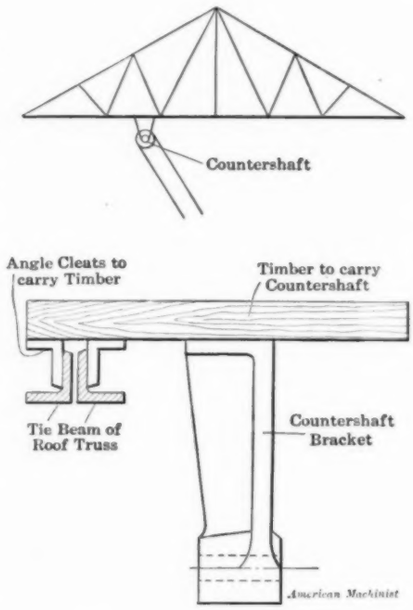
CENTER WITH OIL CUP

A Proposed System of Countershaft Supports

I have lately been planning a machine shop for a manufacturer and to save room, I arranged the countershaft brackets to fasten on the roof truss, as shown in sketches.

The manufacturer said it was unusual and was inclined to object, so I would like the opinion of your readers as to whether this system is open to objection.

In calculating the pull on the countershaft by the belt what should be allowed per inch of width of belt. By this I don't



COUNTERSHAFT SUPPORTS

mean the 50 pounds difference in tension between the two sides, but the total pull of the two sides on the countershaft, tending to pull it down.

Darlington, England. DU PONT.

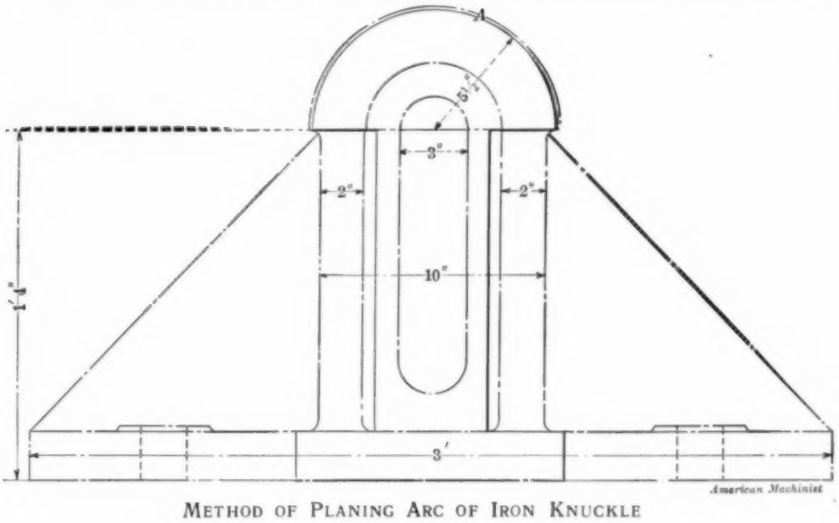
In a paper presented to the International Mining Congress dealing with the proposition of using waste gases as fuel for open-hearth furnaces, it was given as the opinion of the author that in a few years open-hearth furnaces will be operated successfully, using blast-furnace gas wholly or partly. The proposal to regenerate blast-furnace gas by passing it through coke breeze or fine coal heated with oxygen manufactured by the Linde process was supported.

Discussion of Previous Question

How We Machine Those Pieces on a Planer

Letters from our readers showing how many men of many minds look upon various subjects opened up in previous numbers.

In regard to Tynesider's inquiry, on page 1220, Volume 33, Part 2, and your footnote re same. This class of work I am familiar with and we do not use any special rig up on the planer for dealing with it. As to the quantity, *not* specified by Tynesider, my experience is that it may be anything from, say, 8 to 64. I have not in 10 years known of a greater quantity than this of any one radius. Taking the larger quantity to represent the limit of Tynesider's "quite a number," I am of opinion that the editor's suggestion as to rigging up the planer as a mill would not be profitable. I figure it out as follows: Rigging up



METHOD OF PLANING ARC OF IRON KNUCKLE

planer at least £10. (This, of course, is a rig up I have in mind and which may not be the cheapest possible.) At least two built cutters with high-speed steel inserted blades, not less than £12. An expenditure to begin with of, say, £20. As these rocker bearings are cast from metal which is not too clean, the upkeep for blades would be considerable. Again, my experience is that to deal with the various radii on different rockers a set of cutters ranging from 2¼ inches, rising by ¼ inch to 6 inches, would require to be kept on hand, rather too much sunk capital as these cutters would not, in our shop, be of much use for anything else. In any case, the saving affected over a straight planer job would not warrant cost of the rig up except under one condition, and that is, a permanent transformation of the planer to a miller.

The following method of machining these rockers is that in use in our shops. These rockers are invariably cast "fat," i.e., at least ½ inch depth of metal is allowed all over the machined surfaces, this to insure surfaces free from sand and holes.

First the bottoms are planed. This insures a true seat on planer table for planing the radius. A templet is made of ⅛-inch sheet iron and clamped on the end of the casting as shown in the cut. The clamps may be fixed in any suitable manner. This casting is set up on the planer table and clamped down and as many more as the table has capacity for are alined. An ordinary high-speed roughing tool is used first. This is set in a tool bar of the swivel-head pattern and secured in the tool box. The templet acts as a guide to the operator, who by controlling the power cross feed and using the hand vertical feed on the tool box, roughs round the templet pretty near the form required. For finishing two arc spring finishers are used; one right and one left hand. The length of arc of these finishers is one of 60 degrees, with the required radius. This tool is now set to the clamped templet and is manipulated by the hand feed on the tool box. Each tool is set twice during the finishing operation. An excellent job is the result. A horse-shoe type of sheet-iron gage is used for gaging. The average time each to finish this operation on the rocker as shown is 3½ to 4 hours on a planer having one tool box on the cross slide and a capacity of 4 pieces on the table.

There are other ways of doing these on the planer, by means of a former, etc., but I think the above method is likely to be of most assistance to Tynesider and it has proved to be the most economical method of machining this class of work in our shop.

Manchester, Eng. MACSPORRAN.

A Stubborn Repair Job

The account of a stubborn repair job, written by H. B. M., of Milwaukee, Wis., page 839, Vol. 33, Part 1, interested me, particularly the way he got a six-inch standard coupling off its shaft, and the statement he made that it took from three to five men three whole days to do the job, makes one wonder if he is serious or joking.

What about the key? Was there no key in the coupling? I consider a key was, in this case, absolutely necessary, as the coupling bore was lined up with sheet iron and could not have been a good fit to the shaft. He talks about the coupling having been pulled on with a *total* pressure of 50 tons while hot. I wonder how the sheet-iron liners were kept in position while this operation was carried out, and who ever heard of a good fit of a coupling on a shaft with sheet-iron liners to aid?

H. B. M., of Milwaukee, spoiled the coupling and took three days to get it off its shaft, and when "the case was becoming desperate" (whatever that means) he rigged up a large blow-torch to heat the coupling, and kept the shaft cool with asbestos. But he should know that there was little gain from heating the coupling, for, the temperature being raised so slowly, the shaft was heated at the same time, and the shaft being of steel and the coupling of cast-iron, the shaft, by virtue of its greater expansion, would be tighter hot than cold.

It is obvious that H. B. M. was new to the job, or he would not have expected to have pulled that coupling off with a screw-jack.

I have had scores of such jobs to do, and have always provided myself with sufficiently strong gear for the purpose.

In the case referred to, the key should have been first drilled out; and, a good strong circular plate found—an old coupling, for instance—to be fixed with its

boss inward toward the shaft, with a 5¾-inch packing piece between, to impinge on the end of the 6-inch shaft. This pulling plate would require holes in it to match the holes in the coupling on the shaft; say, eight 1½-inch holes. I would have used the whole eight holes in which to put the 1½-inch studs, and secured the full value of the eight by *setting up on each a little at a time*. The tremendous pull we can get on eight studs as set forth will be a surprise to the uninitiated, and it is a splendid reserve in the hands of a careful operator, and may be likened only to the great power exerted by common wood wedges, *when driven a little at a time*, for the purpose of raising a ship for launching.

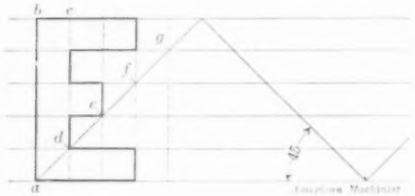
I believe if H. B. M. had followed the method suggested he would have saved his coupling and got through the job in a working day; moreover, he would have considered the job so unimportant that he would never have dreamed of telling us about it. J. T. TOWLSON.

Silvertown, London.

The Section Liner for Lettering

On pages 266-7 appears an article on the use of the section liner for block lettering. For those who use such lettering and have no section liner, the following way will save the time of laying off the vertical spaces.

Draw the six horizontal lines, making the five spaces equal. Start at a point in



LAYING OFF BLOCK LETTERS

the upper line and draw another line at 45 degrees. From where this line intersects the bottom line, draw another at 45 degrees, as in the illustration. Draw as many 45-degree lines as are necessary for the letters. Where these intersect the horizontals, draw the necessary verticals of the letters. The lines being at 45 degrees, they make the vertical spaces equal to the horizontal.

For example: To draw an E, start at, say, *a*, draw a vertical; move the triangle on the T-square until the edge touches the next point of intersection *d*, and draw another vertical. This gives the space *b c* without laying it off. Count from *d* to *e* one space, *e* to *f* another, etc., as many spaces as the letter requires. Only the vertical lines necessary for the letter need be drawn.

This method saves the time of laying off the spaces along the horizontal lines.

Rochester, N. Y. GARSON PRENNER.

Value and Effect of Education

George Stuart takes me to task in a very kindly way at page 268 for my rather radical views in this subject. I do not know that Mr. Stuart's occupation may be, but he appears to have the identical views of the old-time professional educators, and follow their standard line of defense.

One thing I would like to ask him which affects me personally, and that is: Will he elaborate on his statement that "the real loss of respect and control is due to the improper home training of the child, and the public school has little, if any, bearing on the case." This is a live question with me because my small children have much less fear of my displeasure and much more profound contempt for my stock of knowledge, than I had for my parents' when I was their age. It may be a mere coincidence that this has occurred with those in school and that one who has been educated at home, most of the time, does not show it. If he will tell us wherein lies the improper home training, which must be universal about here, I shall be glad to reform.

The trouble with Mr. Stuart and the trouble with the professional educator is that neither can get down to the plane of the average man. They are soaring so high that they do not realize that there are millions of us to whom Balzac is as likely as not the name of a breakfast food, or a Greek god, and that millions before us, and millions to come, have lived, and will live happy, profitable lives, without the favor of that minute coterie of women for whose edification he wishes us trained.

I appreciate now what my father meant the day I started for college. He said, "Go ahead, boy, but it's a shame to ring a hog that has got to root for a living." He meant that the education I was after would put my ambitions so far above my possibilities that they could never meet. To be sure, they have met, but it was because I found that in order to live happily I had to forget most of my college ideals.

ESSENTIALS OF EDUCATION

What I am after is a chance for every boy to have a good, clean cut education in the essentials of life, and a fair, square start in some business, trade or profession that will enable him to earn a living. I should like to see him leave school with a sufficient comprehension of the finer things of life, that after he gets his feet on solid going he will be able to make of himself a cultivated man. Ex-president Eliot is back of the statement that he can do it, and we all know of instances where it has been done. Think of Washington, Franklin, Lincoln, Greeley, Bunyan, Shakespeare, Burns, Washington Irving. None of these men were college men, but they have left behind them works that every college man studies. They all acquired their learning after college age.

AN AWAKENING IN FUTURE COLLEGE COURSES

I believe that the brilliant men, will make their way quite regardless of their early training. The man that needs care is the man who, alone would make $2 a day, but if trained will get $6 or $7. If he goes higher, I believe that no school should claim the credit; he would have gone anyway. For the boy that I am after, it does seem a pity to "ring" him young, when if we feed him only useful, brain-building food, he can later buy himself a solid gold ring, along with all the culture this world holds for any man. College courses in general are built for those few men of genius who really need no help from anybody.

For myself, I have no regrets for my college training, except that I feel that I might as well have been trained in such a way as to have reached my present position ten years ago. The way my children are being handled in school, they will not reach the same position until they are ten years older than I am now. The colleges are handicapped by the preparatory and earlier schools, though even there they are to blame because they have dictated the methods of the lower schools by the way they have set their entrance requirements.

To anyone who attended the recent meeting of the National Education Association in Boston, there is no doubt but that even the educational world is becoming nauseated at its own former methods, and that there is beginning to be a vigorous movement towards educational methods which consider the child to whom genius is forbidden.

Mr. Stuart evidently misunderstands my objections to athletics. My objection is solely to the financial end. In my day we trained ourselves; we made our own hurdles and all the paraphernalia, and we made records that have been beaten only by changes in the mechanical aids of better apparatus. The amount of money spent today is out of all proportion to the amount of sport, and is enough to have branded the whole thing as professional, 20 years ago. I am the last to say anything against purely amateur sport, both in school and shop, for I derived great physical benefit, to say nothing of a couple of quarts of prizes, from that source.

Worcester, Mass. ENTROPY.

Packings for Hydraulic Presses

By A. Lewis Jenkins*

Packings for hydraulic presses are usually made of leather in the shape of cups put around the moving parts. These are sometimes plain cups, sometimes U-cups and also "hat" cups, depending upon diameter of ram and pressure of liquid.

Proportions are given for leather packings, as well as for the glands and stuffing boxes for fibrous packing, together with figures for friction and efficiency.

*Assistant professor mechanical engineering, University of Cincinnati.

The present status of the hydraulic press is largely indebted to the development of packings for high pressures. The problem of retaining a high liquid pressure within the working chamber without leakage and excessive friction has resulted in perfecting two classes of packings—namely, the self-acting leather and rubber packings that are so commonly found on hydraulic machines, and the hemp or fibrous packings mechanically compressed in a stuffing box.

Self-acting Packings

The most perfect packings for rams, plungers and pistons operating against high liquid pressures, are the cup, U and hat-leather packings shown in Figs. 1, 2 and 3.

The self-acting property of a leather packing is due to the pressure of the liquid acting against the internal surface, causing it to expand against the cylinder or ram with sufficient force to prevent leakage.

At first thought it may appear that the whole depth of a cup leather packing is useful in making the joint, but it is easy to imagine a very long cup made of pliable material with its rim hanging perfectly free and only a short portion near the point *A* in Fig. 1 forming the joint. To effect a tight joint the pressure of the cup against the cylinder wall must be at least equal to the pressure of the liquid. At the point *A*, Fig. 1, opposite the clearance space between the ram and cylinder, there is no reaction against the packing and the difference in pressure on the inner and outer surfaces is equal to the pressure of the liquid. Hence, the pressure of the liquid multiplied by the area of the clearance is equal to the total pressure of the packing against the ram and cylinder.

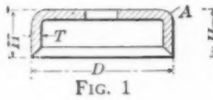


Fig. 1

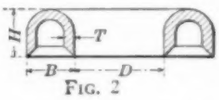


Fig. 2

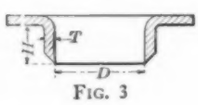


Fig. 3

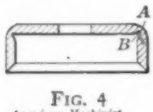


Fig. 4

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Fig. 1. Cup packing. Fig. 2. U packing.

Fig. 3. Hat or flange packing. Fig. 4. Localized wear on packing.

The distribution of the pressure of the leather against the cylinder wall or ram, depends upon the pliability of the packing, and is an important factor in determining the dimension *H* in Figs. 1, 2 and 3. Packings made of soft leather or india rubber have bearing over a very small area on each side of the clearance space and form very effective joints for high pressures, but are objectionable on account of localized wear, as shown in Fig. 4. The wear takes place at *A* due to the friction of the cylinder and the leather is forced out by the pressure, giving an indentation at *B*. To prevent localized wear a hard-finished leather is used which distributes the pressure over a greater area. This relieves the wear at the expense of tightness and it is often necessary to use additional means of pressing the cup against the cylinder. This may be done as shown in Figs. 9 and 10, which will be described later.

Leather packings should be made of sound oak-tanned or Vim leather selected from the best part of the butt. If the packing is not subjected to much wear and is liable to become dry, india rubber may be used.

The manufacture of leather packings is very simple. The leather is made pliable by soaking in water, heated to about 130 degrees Fahrenheit, then pressed into the desired shape with a set of cast-iron dies forced together by a screw or hydraulic press, the mold clamped and placed in a steam-heated oven to dry. When the leather becomes hard and dry it is trimmed to an angle of 45 degrees.

In joining these packings, considerable stress occurs at the point *A*, Fig. 1, and as this stress increases with the depth of the cup, it is inconsistent to make it much deeper than tightness demands.

Cup Packings

The simplest application of the cup packing to hydraulic presses, is shown in Fig. 5, it being secured to the end of the ram by a large washer and cap screw. This is only satisfactory for very small cylinders and comparatively low pressures. Another method very similar to this is shown in Fig. 6, there being very little essential difference. Fig. 7 shows an arrangement that is sometimes used on horizontal and inverted presses for returning the ram.

For high pressure it is necessary to use some mechanical means of expanding the cap against the cylinder wall, and this may be very simply done by compressing a piece of hemp packing against the inside of the cup by a washer, as shown in Fig. 8. Fig. 9 shows a method used for expanding the packing on rams less than 8 inches in diameter. It consists of a rubber, or braided flax ring *R*, compressed between the iron ring *O*, and the cap *D*, by tightening the lower nut *K* on the stud *B*. This causes the ring *R* to expand the lower portion of the cup against the cylinder and thereby effects even wear of the packing. The washer *F* is forced against the leather by the upper nut *K*, and compresses the hemp packing in the space *L*, to prevent leakage around the stud. Rams 8 inches in diameter and over, are provided with a long stud which extends from the lower nut *K* to the top of the ram, thereby providing a means of tightening the packing without removing the ram.

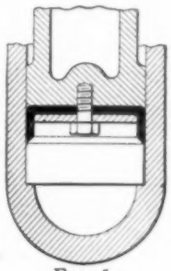
Fig. 5

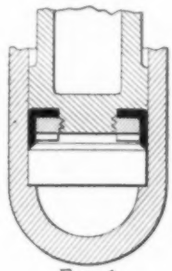
Fig. 6

Simplest method of using cup packing. Simple Method of attaching packing to ram.

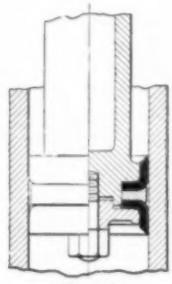
Fig. 7

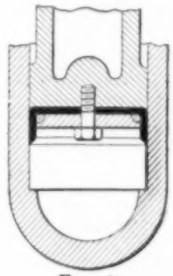
Fig. 8

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Double-acting ram fitted with cup packing. Application of flax ring to increase pressure of packing against cylinder.

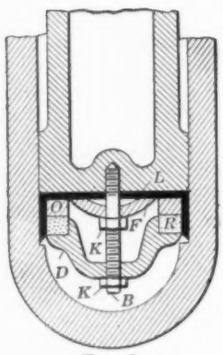

FIG. 9

DETAILS OF ADJUSTABLE PACKING

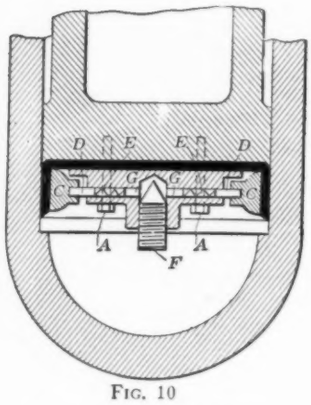

FIG. 10

DETAILS OF AN ADJUSTABLE PACKING

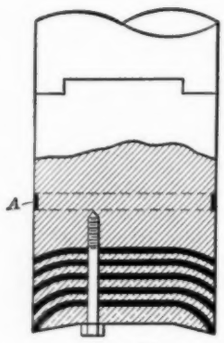

FIG. 11

PACKING USED FOR 105,000 POUNDS PRESSURE PER SQUARE INCH

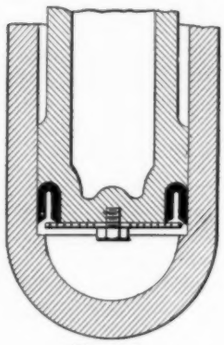

FIG. 12

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U-PACKING ON END OF RAM

Another method of expanding the packing is shown in Fig. 10. The screws *A* clamp the packing to the bottom of the ram with the plate *B*. The expanding ring *C* is made in six segments, each of which is provided with a rod *D* which is forced outwardly by the action of the spring *E*. The thrust of the springs is regulated by the conical-pointed screw *F*, acting against the pointed pins *G*. Large cylinders are provided with a tee-fitting at the bottom, which permits the insertion of a special wrench for adjusting the screw *F*.

Fig. 11 shows the lower end of a ram used on the Huber forming press, built at the Krupp works. The ring *A* is of copper and the packing consists of alternate layers of brass and leather so arranged as to be self acting. This packing has met the requirements for high pressure by operating successfully against a pressure of 105,000 pounds per square inch.

U-Packings

The U, or double-cup packing, was invented by Benjamin Hick and was used by Bramah on the first hydraulic press. Fig. 12 shows the application of this packing to the end of the ram, in which case the cylinder is lined, or finished the same as for cup packing. In Fig. 13 the packing is placed in a cavity near the top of the cylinder by bending it as shown in Fig. 14. This construction is not expensive, but there is some difficulty in getting the top of the cavity bored to fit the packing and it is also difficult to replace the packing. A better practice is to use a gland in the neck of the cylinder, as shown in Fig. 15.

For all U-packings there should be 1/16 to 3/16 clearance in the bottom of the cavity to allow the liquid free access to the interior, and the annular space between the inner walls should be filled with hemp, or other material to keep the packing in shape and force it against the ram when the pressure is off. A wood, or brass ring is sometimes placed within the packing to prevent it from striking the bottom of the cavity when the ram returns. Large packings are sometimes provided with an internal brass ring, as shown in Fig. 16. A brass guard ring *A*, Fig. 16, was introduced by Tweddell to prevent wear, but is seldom used. A pad of fibrous packing inserted above the leather is considered good practice when the gland does not fit the top of the packing.

Fig. 17 shows an india-rubber packing, that consists of a hollow ring, rectangular in cross-section, provided with holes in the bottom permitting the liquid to enter the interior. U-packing made of rubber and cloth, having about the same composition as rubber belting, is satisfactory for moderate pressures of water.

It is difficult to secure a piece of suitable leather that is large enough to make packings over 30 inches diameter. In such cases the leather is cut in strips about two inches wide and spliced with chamfered joints about five inches long. The laps are then stretched across one edge, forming a belt-like ring, equal in diameter to the recess in the cylinder. The edges are tapered, the leather soaked in water, then bent by hand into the U form and inserted in place.

Hat Packings

Hat, or flange packings are frequently used on swivels, operating valves and rods not exceeding 3 inches diameter. They are also made in larger diameters for hydraulic elevator plungers. Fig. 18 shows a hat and cup packing used in the

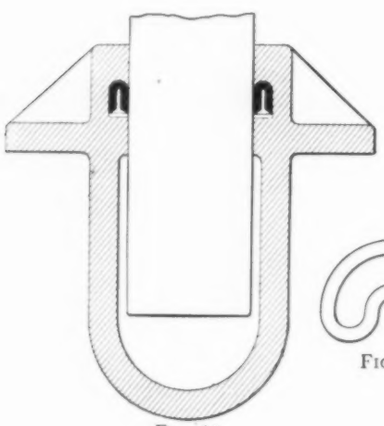


FIG. 13

U-PACKING IN WALL OR NECK OF CYLINDER

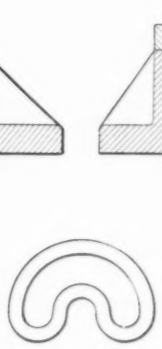


FIG. 14

U-PACKING BENT FOR INSERTION IN CYLINDER

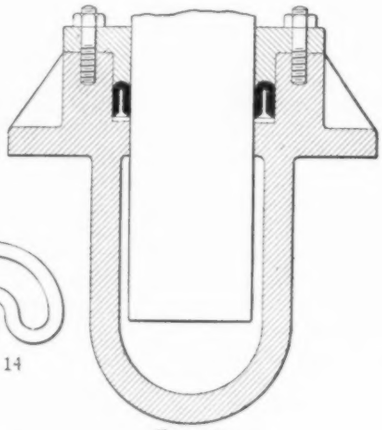


FIG. 15

U-PACKING IN NECK OF CYLINDER WITH GLAND

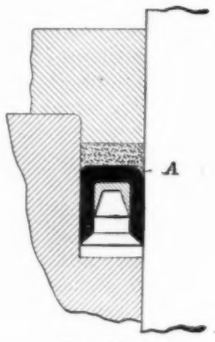


FIG. 16

U-PACKING WITH INTERNAL GUARD AND FLAX PAD

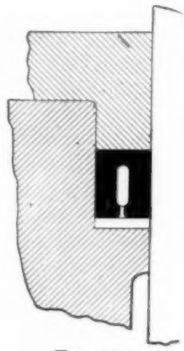


FIG. 17

American Machinist

INDIA RUBBER U-PACKING

"draw back" cylinder of an inverted press, the top of the cylinder being open the liquid enters the cylinder and lifts the piston which is connected to the platen of the press.

Spiral Packing

Another form of self-acting packing is shown in Fig. 19. It consists of a single strip of leather 3/16 to ¼ inch wide and of sufficient length to wrap around the ram five or six times. This is a very satisfactory packing for small pump plungers and rams not exceeding 1 to 1½ inches diameter.

Hemp or Fibrous Packing

The first fibrous packings were made from loosely twisted strands of flax, saturated with hot tallow and wound around the ram until the stuffing box was full. This answered the purpose very well for low pressures, but soon became hard. The next step was to use braided flax, or hemp, with a rubber core to give resilience. The great demand for steam, water and ammonia packings caused strong competition and the introduction of machines and processes for combining hemp, flax, cotton, rubber, graphite and oils which led to a great many varieties and the development of packings suitable for very high pressures.

A good packing must be pliable enough to readily adjust itself to the shape of the stuffing box and firm enough to resist friction of the ram and pressures of the gland and liquid. In order to insure pliability, the packing must not dry out or harden, and this dictates the use of such materials as graphite, rubber and tallow; and to secure the necessary firmness and strength, flax, cotton and sometimes copper wire are introduced.

Contrary to the general supposition, fibrous packings are satisfactory for pressures up to 2500 and, in some cases, as high as 6000 pounds per square inch. They are less expensive, more accessible and wear longer than leather packing, but produce greater friction and wear on the ram. They are much better than leather packings if the working liquid contains any gritty matter.

Proportions for Leather Packings

The proportions for leather packings are far from being standard. One of the leading manufacturers states that "nearly every customer on our books, when ordering, will specify packings which vary somewhat from any other customer."

The required thickness of leather depends upon the pressure, depth of cup, and somewhat on the diameter of the ram. There is but little need of making it greater than 3-16 of an inch, although in practice it varies from ⅛ to ¼ of an inch. Mr. Welch (Proc. Inst. Mech. Eng., 1876) proposed the formula

$$T = 0.156\,D^{0.28}$$

which gives a greater value for the larger sizes than practice recommends.

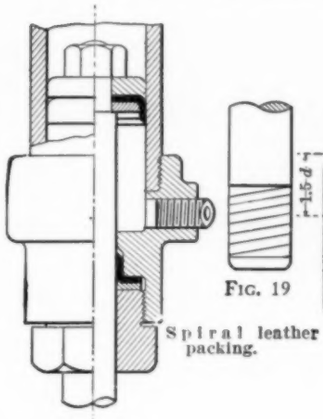


Fig. 18

Details of drawing cylinder.

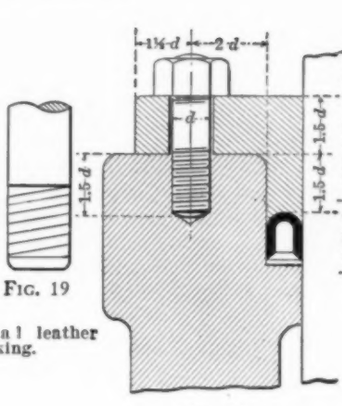


Fig. 19

Fig. 20

Proportions of gland for U packing.

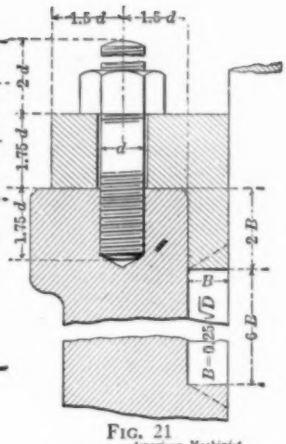


Fig. 21

Proportions of gland and stuffing box for fibrous packing.

The depth H in Figs. 1, 2 and 3, depends upon the softness and thickness of the leather and varies from ⅝ inch to 2 inches. Welch suggested making the depth equal to 2.5 T, but this differs considerably from the valves used in practice. About one inch is sufficient to make a tight joint, and it is prejudicial to make the cup unduly deep, as the stress in the leather during manufacture is greatly increased by increasing the depth. This stress is also greatest on the portion subjected to greatest wear, and unless considerable care is exercised in the manufacture, the leather is liable to tear or suffer deterioration, which will afterward be revealed in the short life of the packing. The adjustable packings shown in Figs. 9 and 10 must accommodate the expanding rings and require a deeper cup than would otherwise be necessary.

The breadth B, Fig. 2, of U-packings depends upon the thickness, and should be made as small as possible without injuring the leather. Any increase in breadth requires a stronger gland and more studs to hold it in place. The breadth of soft leather may be about 5/6 of an inch, and for oak-tanned, hard-finished leather, ¾ of an inch is satisfactory.

In the accompanying table proportions are given that have been extensively used and are recommended for U and cup leather packings made of oak-tanned leather. If Vim leather is used, the thickness should be reduced to 3/16 of an inch and all hat, cup and U packings not requiring an expanding ring should have the following depths:

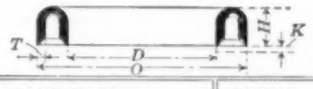
Diameter of cylinder...	4,	6,	8,	10	inches and over.
Depth, H....	⅝,	1,	1¼,	1¾	inches and over.

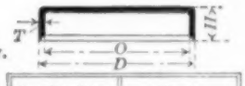
The breadth of a cavity for a U-packing should be about 1/32 to 1/16 of an inch less than the packing to insure close fitting, and the hight 1/16 to 3/16 of an inch greater, to allow liquid free access to the interior. The top of the cavity should be finished to fit the curvature of the packing, or filled with hemp. When a gland is used, as shown in Fig. 15, the sharp edges on the end of the barrel should be slightly rounded to prevent cutting the packing.

Glands for U-Packings

There is no initial tension necessary in the gland studs and they only carry the load due to the pressure of the liquid in the cavity, which is equal to

$$P \pi B\ (B + D)$$





End U-Packing					U-Wall, or Neck Packing				Cup Packing		Stock	
Diam. of Ram	D	O	H	T	D	O	H	K	D	H	Diam.	Thick.
4"	2⅝"	4"	⅝"	5/16"	4"	3⅝"	1"	1/16"	4"	1"	6"	5/16"
6"	4⅝"	6"	1"	5/16"	6"	7⅛"	1⅛"	1/16"	6"	1¼"	8½"	5/16"
8"	6⅝"	8"	1⅛"	5/16"	8"	9⅛"	1¼"	1/16"	8"	1½"	11"	5/16"
10"	8⅛"	10"	1¼"	¼"	10"	11⅛"	1⅜"	1/16"	10"	1½"	13"	¼"
12"	10⅛"	12"	1½"	¼"	12"	13⅛"	1⅜"	1/16"	12"	1½"	15"	¼"
13"	11⅛"	13"	1½"	¼"	13"	14⅛"	1⅜"	1/16"	13"	1¾"	16½"	¼"
14"	12⅛"	14"	1½"	¼"	14"	15⅛"	1¼"	1/16"	14"	1¾"	17½"	¼"
18"	16⅛"	18"	1¾"	¼"	18"	19⅛"	1⅜"	5/16"	18"	2"	22"	¼"
21"	19⅛"	21"	1¾"	¼"	21"	22⅛"	1⅜"	5/16"	21"	2"	25"	¼"
23"	21⅛"	23"	1¾"	¼"	23"	24⅛"	1⅜"	5/16"	23"	2"	27"	¼"
24"	22⅛"	24"	1⅜"	¼"	24"	25⅛"	1⅜"	5/16"	24"	2"	28"	¼"

Proportions for Oak-tanned Leather Hydraulic Packings

where p is the pressure of the liquid, D the diameter of the ram, and B the breadth of cavity.

The sum of the areas at the root of the thread of all the studs is

$$A = \frac{P \pi B (B + D)}{S},$$

where S is the unit stress in the stud and may be taken as 10,000 to 15,000 pounds per square inch.

The next step is to determine the number of studs, by assuming a diameter and solving for N, in the formula

$$N = \frac{A}{a}$$

when A is the area of stud at the root of the thread, if the stud assumed be too small a large stud circle will result and it will be necessary to use a larger size.

The space between the studs should be sufficient to permit the use of a standard wrench, which requires the spacing to be about 3.25 d, but for high pressures it is frequently necessary to reduce the spacing to about 2 d, which will allow about ¼ inch clearance between the nuts. If the stud circle is too small, the liquid is liable to ooze through the material and leak around the studs, and if too large, it will be necessary to flange the cylinders. In this connection, the platen boss may become a consideration, as it is liable to strike the nuts, or studs, and not go entirely down. The proportions for glands shown in Fig. 20 have proved satisfactory.

Proportions for Stuffing Boxes

The proportions for stuffing boxes in Fig. 21 have proved satisfactory, where a good quality of packing was used.

There exists a difference of opinion regarding the shape of the bottom of a stuffing box; some designers claiming that a taper as shown by the dotted lines in Fig. 21, forces the packing against the ram sufficiently to make a tight joint without compressing it sufficiently to cause it to harden and score the ram; whereas, others insist on the design as shown, claiming that taper increases friction and is liable to permit leakage around the outside of the packing and under the gland.

The breadth B, in Fig. 20, is made equal to the breadth of the packing, which varies from ¼ inch to 1¼ inches, advancing by eighths, and may be determined by the formula:

$$B = 0.25 \sqrt{D}$$

where D is the diameter of the ram.

The depth of the stuffing box may vary from 6 B to 8 B, depending upon the pressure and frequency of operation of the machine Increasing the depth increases the amount of packing it will hold, decreases the necessary tension in the gland studs and requires less attention.

The size and number of studs may be determined for the leather packings, by increasing the total bolt area about 12 per cent.

Efficiency of Packing

By efficiency of packing is meant the ratio:

$$\frac{\textit{total pressure on bottom of ram} - \textit{friction of packing}}{\textit{total pressure on bottom of ram}}$$

and may be expressed by the formula.

$$E = \left(1 - \frac{4F}{\pi D^2 = p}\right) 100 \textit{ per cent.}$$

Where F is the frictional resistance offered by the packing.

From the experiments of John Hick, the frictional resistance for leather packings is

$$F = C p D$$

where C is a constant and equal to 0.0314 for leathers in good condition and 0.047 if new, or badly lubricated.

By substituting the value of F, the efficiency of leather packing in good condition is

$$E = \left(1 - \frac{0.04}{D}\right) 100 \textit{ per cent.}$$

The resistance of fibrous packing varies with the depth of stuffing box and the degree of compression applied by the gland. Under the same degree of compression a long stuffing box would offer more frictional resistance than a short one, but a deep stuffing box will not require as much pressure to effect water tightness, hence, the friction of a short stuffing box may be greater than a long one.

If the stuffing box is of the proportions given in Fig. 21 and the studs not unduly tight, the frictional resistance may be expressed by the simple formula

$$F = 0.2 p D$$

This value substituted in the formula for efficiency gives

$$E = \left(1 - \frac{0.254}{D}\right) \qquad \textit{cnt.}$$

To show the application of the above formula, suppose it is desired to determine the effective pressure of the platen against the material in a press having a 10-inch cylinder, packed with fibrous packing; working pressure of the liquid 2000 pounds per sq.in. and weight of ram and platen 1200 pounds.

The total pressure exerted on the bottom of the ram is 78.54 tons; the force required to overcome friction of the packing is $F = 0.2 \times 2000 \times 10 = 4000$ pounds. The net pressure on the platen then is

$$78.54 - \frac{4000 + 1200}{2000} = 75.94 \textit{ tons}$$

The efficiency of the machine is

$$(75.94 \div 78.54)\ 100 = 96.7 \textit{ per cent.}$$

Turning Boss from Rocker Arms

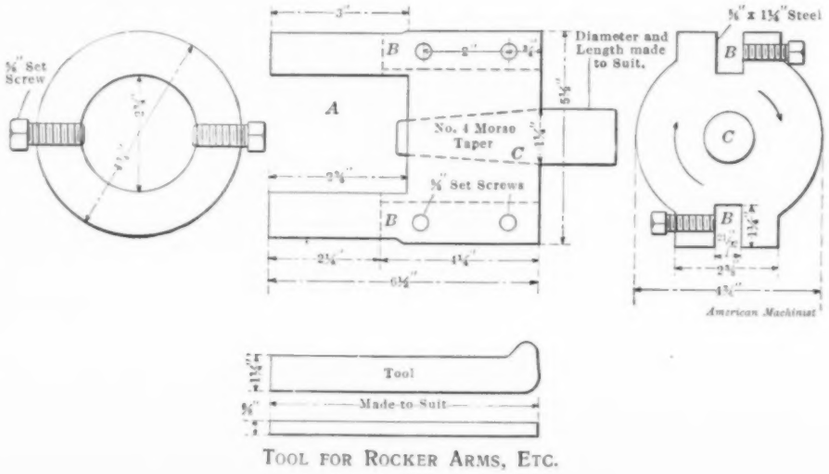
By W. H. Snyder

In locomotive-repair shops where machines and tools are limited for machining rocker arms, side rods with solid oil cups, etc., there have to be special tools made to help the work along as rapidly as possible.

The accompanying sketch shows a tool that I designed for turning the bosses from rocker arms, etc. It has proved a great help, as this kind of work has to be done on a drill press.

The end A is bored to fit the drill-press spindle, and is fastened with two ⅝-inch steel set screws. The slots B B are shaped to take ⅝x1¼-inch high-speed steel tools, and each tool is secured with two ⅝-inch steel set screws. By drilling an 11/16-inch hole, 4½ inches from the bottom, the slots can be shaped very handily.

The hole C is bored and reamed to fit a No. 4 Morse taper shank. A piece can be fitted it with an end projecting that can be made to suit any size hole. This projection is used as a steady.



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American Machinist

Editorial

Scholarships for Deserving Young Men

The question is often raised as to how a deserving young mechanic is to obtain a technical education. This is too often put aside with the statement that if a young man deserves to succeed he will find the way. We know that some deserving men do find the way, but we also know there are many others equally deserving, who are unable to obtain a technical education. Many have to support mothers and fathers, and it is impossible to save for an education.

In nearly every shop of importance, will be found one or more apprentices, or young mechanics, who have the making of good engineers or shop managers, if given an opportunity to obtain an education. Some of these are intensely ambitious, and will make many sacrifices to obtain the necessary technical learning. It should be possible for men of this kind to obtain the education necessary to fit them for higher work.

In Scotland, many of the engineering and shipbuilding firms give scholarships at the engineering schools to their most deserving apprentices and young mechanics, and some give scholarships at the University of Glasgow. We believe that our manufacturing establishments would find it to their ultimate advantage to establish similar scholarships at our best engineering schools as a special reward of the best service.

Such a course would raise the standard of the apprentice system, and better service be secured. In most cases the young mechanic, after he has obtained his education, would return to the works where he learned his trade. And with his intimate knowledge of the product of the establishment, together with his feeling of loyalty to the firm, excellent services should be rendered. While a few of those educated would rise to the higher engineering positions, the majority would stop at the position of superintendent or general foreman and bring to these positions not only the necessary education, but thorough practical training. At present there is a great scarcity of men of this kind, and many an employer feels the need of such foremen and superintendents.

The establishment of such scholarships should materially improve the efficiency of our shops, and in the years to come the men thus educated would materially assist in fighting our national battle for engineering and commercial supremacy.

Jumping at Conclusions

Jumping at conclusions seems to be one of the most popular of exercises for all classes and conditions of people. And the jumping is not so bad in itself if we did not talk about it before we really found out that it was not half as bad as it seemed.

When we venture to remark that the tendency in manufacturing is toward single-purpose tools, meaning tools built for doing one particular job and nothing else, some jump at the conclusion that we mean that there is no field for any general tool in a modern shop.

If we illustrate a lathe that is being built by John Jones that looks very much like any other lathe of its kind and may even be worse than most of them, some jump at the conclusion that we are indorsing this particular machine.

As a matter of fact, none of the critics will deny that, where there is work enough to warrant it, the way to machine any piece is to have a machine especially for that and nothing else. It saves all setting up or changing over and it can often be built for a small sum because it needs but few parts and almost no adjustments.

But we all realize that where there is a case of this kind there are a hundred cases requiring a tool which can be adapted to any work within its range. If we made enough flywheels of one size to warrant a special machine that would handle nothing else, it would be easy to make a sort of boring mill or lathe which would do the work quickly and require very few adjustments. But where there is one case of this kind there are hundreds where the modern boring mill or lathe is the only thing to use because it is easily adapted to different classes of work which must be done.

The machine which is capable of handling a large variety of work economically will always be in demand in spite of the steady growth of the single-purpose tool.

The mere illustration of a new lathe is simply a matter of news that John Jones is building this kind of a machine. We are not in any sense sponsors for

its virtues or its vices; we simply tell you that it is being built.

If we can get into the habit of considering that statements refer to specific instances and not to a sweeping condemnation of a whole class, we will do less jumping at conclusions and come nearer seeing just what was intended.

Keeping Time Records

We usually associate the keeping of time records with piece work or some other special plan for paying labor, but it is useful in many shops where the day-wage system is still in force. In no other way is it possible to know the relative value of the men employed and it calls your attention automatically to operations that are taking more time than they should.

In one shop that we know of the record cards are used to advantage in several ways. After they had been kept for some time they showed very plainly that a few men were doing much more work than the average. These men were given a voluntary advance in pay and the reason for doing so was soon known to most of the shop, as news of this kind travels rapidly.

Others immediately asked for an increase but were confronted with their time cards, showing that their work was not above the average, and that their demand was unjust. When it became known that pay would depend on the records of the time cards, a noticeable improvement took place in many cases.

Another good use of these time cards is the ability to tell a new man, or an old one for that matter, the time a certain job should take.

In some cases slow men have asked for the best time and, with that as an incentive, have materially improved their own time on the same work.

Time records and the assurance of a square deal will do much toward improving the output and the harmony in any shop.

New Publications

THE TWENTIETH CENTURY SHEET METAL WORKER," by H. E. Osborne. 86 5x7½-in. pages, with numerous illustrations. The American Artisan, Chicago. Price in flexible cover, 60 cents; in cloth, $1.

This little volume is intended for sheet metal workers. Beginning with a few geometrical problems, it proceeds with others of a strictly practical character, such as those connected with the making of chimney tops and saddles, roof gutters of various types, furnace-pipe connections, etc. The book is plainly written and the illustrations are clear and good. It should prove useful to those engaged in the industry to which it relates.

COMPRESSED AIR THEORY AND COMPUTATIONS, by Elmer G. Harris. 123 6x9-in. pages, with numerous text cuts, full-page plates and tables. The McGraw-Hill Book Company, New York and London. Price $1.50.

As stated in the preface, this book is intended for college-trained men and it is hence distinctly mathematical. At the same time it contains the best collection of tables and charts for facilitating calculations connected with compressed-air installations that we have seen, and these tables and charts are available to anyone. In addition to the topics commonly included under the subject of compressed air, chapters are included on the hydraulic air compressor and the air-lift pump. The book contains no waste material, but on the other hand is extremely compact and those who are able to read it will find it an extremely satisfactory treatise on its subject.

HIGH SPEED STEEL, by O. M. Becker. 360 6x9 pages, with 272 illustrations. McGraw-Hill Book Company, New York. Price, $4.00.

This is the most exhaustive work that has ever been brought out on high-speed steel. It starts with a history of iron and steel making, which was first ascribed to Tubal-Cain some 38 centuries B. C., and brings it down through the various stages of development to the present day. The author shows that he has studied everything which has been written on the subject of high-speed steel, and the greater part of it has been used in preparing this book. Fred. W. Taylor's address before the American Society of Mechanical Engineers, entitled "The Art of Cutting Metals," has been used to a very large extent, and numerous tables, charts and illustrations have been reproduced.

The various materials that enter into the composition of high-speed steel have had their properties described, as well as their effect upon steel noted. The several processes that are used in the manufactue of steel are also described. These, as well as a large part of the other matter in the book, are as applicable to ordinary steel as to high-speed steel; in fact, the book contains a large amount of material that cannot strictly be confined to high-speed steel.

The methods of working the steel into shape for tools by forging, machining, grinding, etc., are well described, and the angle that should be given to the cutting edge of tools for various purposes is gone into in detail. Sets of gages that can be used for getting the proper angle of the cutting edge when forging and grinding them are also illustrated and described.

The annealing, hardening and tempering of high-speed steel have been extensively treated, and the changes that take place in the metal, by submitting it to heat, or suddenly cooling it from high temperatures, have been explained. The furnaces, baths and the apparatus used for high-speed steels are also illustrated, and the various kinds of pyrometers for measuring the temperatures when heat treating the metal are illustrated and described.

A large part of the book is devoted to the work done by and with high-speed steel, and the various tools into which it is made, as well as the machines on which these tools are used. The amount of work that has been performed under various conditions, the size of chips that have been cut with high-speed tools, and the speeds and feeds at which the tools can be run, have been treated quite extensively. Numerous charts and tables for guidance in the setting up of machines to do different classes of work are given and also, to determine cutting speeds, time of turning operations, amount of metal removed and cost of removing it, and a card system of records for cost accounting is outlined. Tables containing the chemical analysis of many different brands of high-speed steel are also given.

Personals*

W. H. Greul, formerly manager of the Vaughn Bros. Company, Camden, N. J., has been appointed construction superintendent of the Otis Elevator Company, New York City.

James A. Sherwood, for the past five years with E. S. Jackman & Co., Chicago, Ill., has been appointed Canadian agent for Thomas Firth & Sons, Ltd., Sheffield, Eng.

J. H. Gill, assistant professor of machine construction at the University of Illinois, has resigned in order to accept the position of director of the Columbus Trades School, Columbus, Ohio.

J. E. Johnson, Jr., until recently general superintendent of the Thomas division of the Republic Iron and Steel Company, Thomas, Ala., has become manager of the Lake Superior Iron and Chemical Company, Ashland, Wis.

George H. Cheney, until recently manager of the small tool department of the Barber-Colman Company, Rockford, Ill., has severed his connection with that firm in order to accept the position of factory manager with the Reynolds Motor Company, Detroit, Mich.

Arthur Fritsch, formerly connected with the engineering and sales departments of the Allis-Chalmers Company, has been made manager of the Chicago office of the Pawling & Harnischfeger Company, Milwaukee, Wis., succeeding W. E. Kreamer, resigned.

*Items for this column are solicited.

New Tools and Shop Appliances

Some New Grinding Machines

The Diamond Machine Company, Providence, R. I., has been developing new grinding machines, as well as re-designing some of its older types. The most radical departure is in the traveling-head face grinder shown in Figs. 1 and 2, which, though designed primarily for architectural work, is now being used on machine work generally, as can be seen from the piece of work which is clamped to the table. The long stationary table

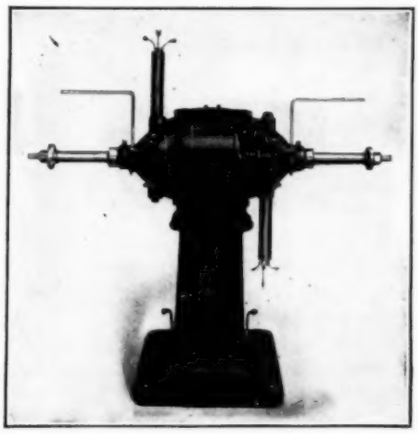


FIG. 3. MOTOR-DRIVEN POLISHING MACHINE

allows continuous grinding, as work can be set at one end while the wheel is at work on the other pieces. The table shown is built to carry work 12 feet long, while the whole machine is 22 feet in length. It is, however, built to suit any requirement as to length of the work.

The face grinding wheel is 30 inches in diameter, is held in a steel-bound chuck and driven by a direct-coupled 15-horse-power motor. The back end of the same shaft furnishes power for the feed

ANY and all new or improved machines, tools, or shop appliances of interest to men responsible for results in machinery-making plants will be briefly illustrated and described here—the machine shop news.

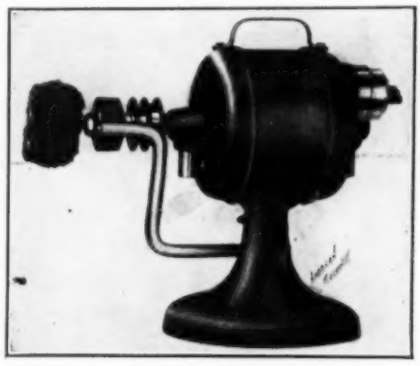
A more full and detailed description will be given—when it is real news—if it can appear here first—before it is sent to other papers. All descriptions appear in ALL four editions of the paper—Weekly, Monthly, Weekly English and Weekly German.

mechanism, which is so clearly shown as to need no detailed description. This feed can be stopped or reversed either by hand or power and can be fed by hand when desired. There is an automatic cross feed of the wheel to the work, which insures maximum production, as well as allows grinding to a fixed depth to insure clean surfacing of the work.

Fig. 3 shows a new type of motor-driven polishing machine with a positive system for keeping the motor cool under the most severe conditions. A fan is mounted on the motor shaft which can be seen through the break in the case and draws a constant supply of fresh air from the small sand pipe at the other end of the case, through the armature and discharges it below. This outlet is connected with the exhaust system behind the polishing wheels, which aids in securing perfect circulation.

A Small Westinghouse Motor

This motor made by the Westinghouse Electric and Manufacturing Company, Pittsburg, Penn., can be readily arranged to operate small buffing, polishing and



A SMALL WESTINGHOUSE MOTOR

grinding wheels, ventilating blowers, small lathes, etc. The motor is supplied complete with one or more attachments. Further attachments can be obtained as desired.

They are made for operation on 115 and 230-volt direct-current circuits, and on 110 and 220-volt alternating circuits of 60 and 133 cycles. The direct-current motors are shunt wound, while the alternating-current motors are of the induction type, single phase. The motors run at a speed of 1700 revolutions per minute. The motor is light and can be easily carried from place to place by means of a handle in the top of the frame.

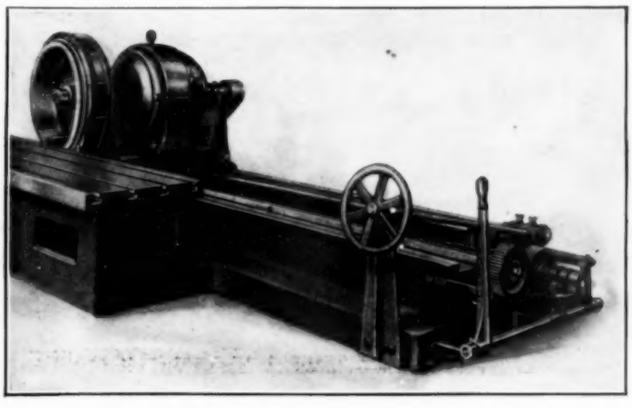


FIG. 1

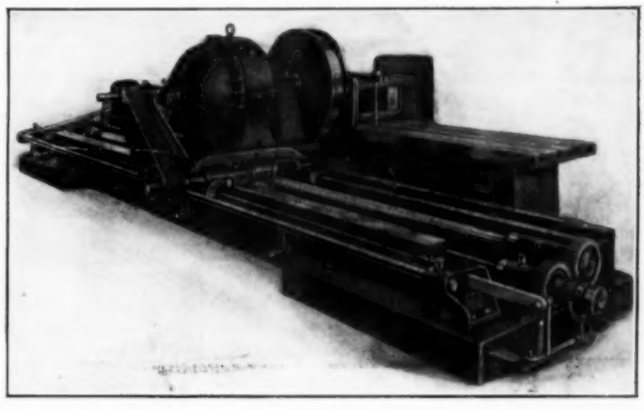


FIG. 2

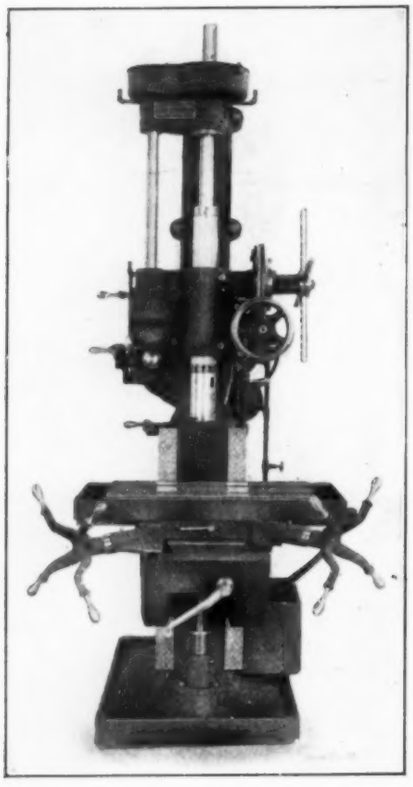
TRAVELING-HEAD FACE GRINDER

A Drill Press Table

The halftone shows a new design of compound table which has been added to the Colburn heavy duty drill press, built by the Colburn Machine Tool Company, Franklin, Penn., and illustrated on page 1189, Vol. 33, Part 1.

This table has a rapid movement through worm and rack, of 20 inches longitudinally and 8 inches crosswise. The operator can stand directly in front of the table in the best position for operating the machine, and without moving from his position, by taking hold of the handles, move the table in either direction longitudinally or in and out.

It also has all the advantages of the old-fashioned circular table in quick adjustment. It is impossible for this compound table to spring, as it has a massive bracket underneath, and the table elevating screw gives an additional support.



HEAVY-DUTY DRILL PRESS WITH COMPOUND TABLE

There is a large chip pan at each end, and an oil groove running lengthwise at each side. It is so arranged that all lubricant running into the chip pan at the further end is drained back by means of a cored opening through the table to the chip pan nearest the tank. From this pan the lubricant is piped to the tank by means of a hose and suitable connections; thus no matter how large a stream of lubricant is used, it all drains back to the supply tank at the side of the machine.

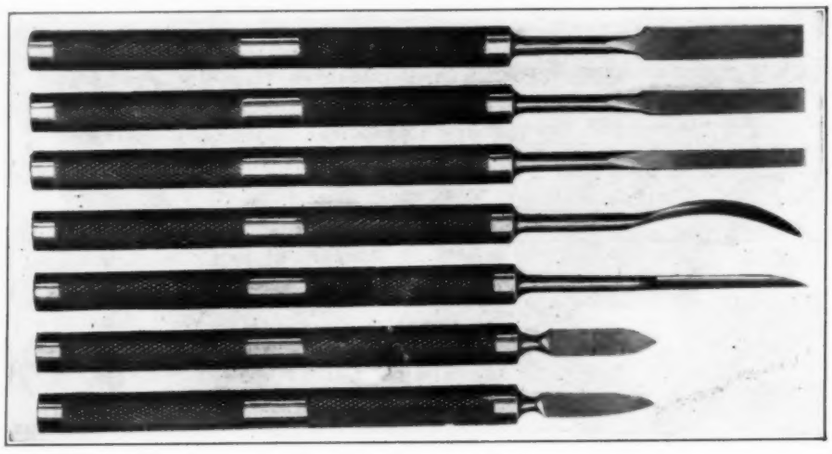
A Set of Toolmakers' Scrapers

The halftone shows a very handy set of toolmakers' scrapers which is being put on the market by the J. E. Poorman Company, Inc., 1825 Bristol street, Philadelphia, Penn.

The handles are light and strong, being made of solid drawn steel tubing nurled for a grip. The blades are of high-grade tool steel ground after hardening. The flat scrapers are respectively, 5/16, ¼ and 3/16 inch wide. The half-round scraper is made in two shapes, straight and curved, both of which are 5/16 inch wide.

The triangular scrapers, ground hollow on the sides, are made in two sizes, 7/32 and 9/32 inch, respectively, across.

Although these scrapers are known as *toolmakers'* scrapers they will be found useful by all metal workers.

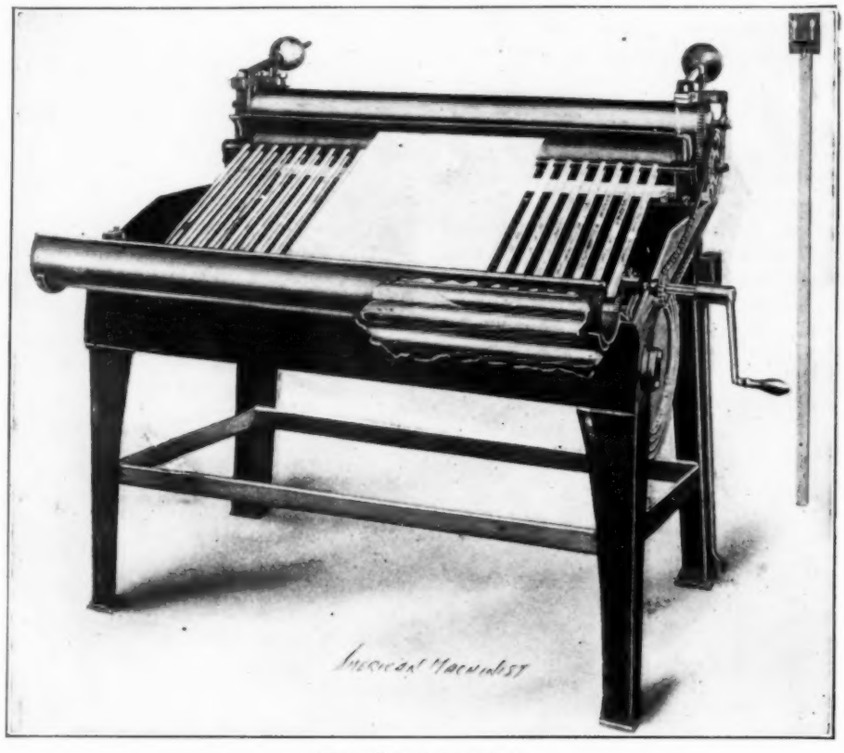


A SET OF TOOLMAKERS' SCRAPERS

The Mechanigraph

The machine, shown in the halftone, transforms opaque drawing paper, after it has been drawn upon, into a translucent paper similar to tracing paper, enabling it to be used for the production of blueprints.

At the front of the machine is a pair of steel rollers, parts of which are readily seen through the opening shown broken in the illustration. Beneath the lower one of these rollers is a receptacle for the chemical which renders the paper translucent. Beyond the rollers is a se-



THE MECHANIGRAPH

ries of traveling tape belts which convey the treated drawing to the upper pair of rollers, which remove the surplus chemical, and finish the translucency and deposit it at the rear of the machine.

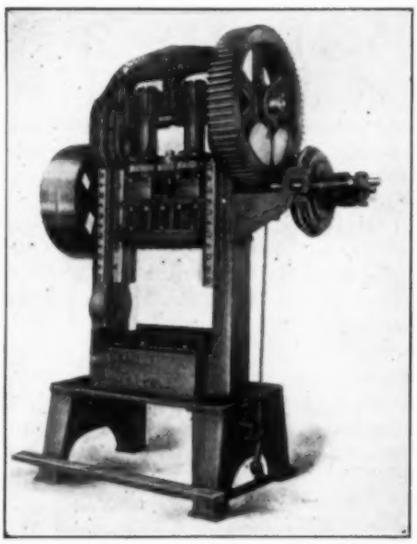
The operation is as follows: The trough at the front is filled to the required depth with the translucifying fluid. Beneath the trough is a heater, operated in the machine shown by electricity. After the fluid has attained the correct temperature, the drawing is inserted between the two front rolls, the bottom roll picking up the fluid and pressing it into the drawing as it passes through. On leaving the rolls the drawing is carried by the conveyer belts to the calender rolls at the top. The upper roll is covered with a special surfacing paper while an automatic slide inserts a flat sheet of the same paper between the drawing and the lower roll. The surplus chemical is absorbed by the surfacing paper and the drawing comes from the upper rolls ready to be used as a blueprint. The drawing can be made in lead pencil, on any smooth surfaced paper, the process darkens the pencil marks and makes the unpenciled part of the paper translucent in proportion to its thinness. No grippers of any sort are used and the drawing is not distorted in any way. It takes about five minutes to start with a cold solution, after which the action of the machine is continuous.

The machine is shipped ready to connect to the electrical installation, provided with six dozen sheets of surfacing paper, sufficient solution to treat 5000 square yards of drawings, and a tool kit.

It is made by Topping Brothers, 122 Chambers street, New York.

A Special Double Crank Press

The halftone shows a specal straight-sided double-crank press so designed that it will stop at any angle of its stroke by simply removing the foot from the foot treadle. The machine is driven by friction clutch, fitted with a brake band on its rim. When the treadle is compressed the friction clutch engages and the brake band is released; when the treadle is released the compression spring, shown in cut, disengages the clutch and the rod upon which the spring is carried being connected with the brake band, compresses it and instantly stops the machine.



SPECIAL DOUBLE-CRANK PRESS

This machine, designed by H. C. H. Walsh, was built by the Walsh Press and Die Company, 4709-11 W. Kinzie street, Chicago, Ill., for the production of horseshoe magnets.

Is Future of the Machinist Doomed?

By Entropy

Some speculations as to how far shop system may be carried in the future and suggestions as to how to be among the "survival of the fittest."

We have seen the driver of the stage and of the street car forced out of business by the progress of invention. Are we to see the machinist forced to follow in the same path? I am led to this query by the growth of interest in the Taylor methods of shop management. These methods, if followed to the bitter end, lead to the division of our shops along military lines into men whose duties are to think and plan and men whose duty, one and only, is to do as they are told.

When this method of management comes into a shop the old-line machinist, who thinks he knows how to rig up and do any job that may come along, has to make his choice between stepping down and simply obeying orders, stepping up and planning work for others to do or stepping out altogether. Since not more than one in ten has the necessary education to step up and the other nine have too much pride to step down, the conclusion is obvious.

Without passing on the merits of the Taylor method, it is enough to say that it will unquestionably be thoroughly tried out under various names, and there is no doubt but that a demand will arise for men to make up operation sheets and decide on rates, etc. This number will be less than the number of skilled machinists now employed. The balance of the shop crew can be made up of men who know enough to keep the tail center oiled and read a micrometer. Six months' experience will make a man who can obey orders. Inevitably this means that many men now drawing wages as machinists will be reduced to their level.

TWO OPENINGS

Painted as black as this, the future of many men now employed looks dark. There are however, two openings. One is for men to so perfect themselves in the details and principles of the trade that when a change in management comes in their shops they will be the ones naturally selected as task setters. It may be said that these places will be taken by technical graduates, but we believe that this will not be the case, for green graduates will not be sufficiently experienced nor mature and older graduates will not be attracted by the work nor by the probable pay.

Again, machinists who are thrown out of employment in this way will likely find that jobbing shops in the vicinity will prosper, owing to the fact that work of an irregular nature will no longer be attractive to manufacturing shops. It will likely be found well nigh impossible to carry the Taylor system into jobbing shops for the reason that a large part of their work can be done in less time than it would take to make out an operation sheet for it.

Likewise tool making will probably continue to be a real machinist's job, except where it becomes repetition work. In fact, we believe that with only the possible adaptation which tends to elevate the trade, there is no cause for apprehension for skilled men. There is, however, a large class of men who are really operatives but who are styled machinists, who are today drawing more pay than their intelligence and skill entitle them to merely because we are in the habit of rating any man a machinist who run a machine tool. These men may easily drop to the level natural to a trade or a calling which can be mastered quickly.

Catalogs Wanted

Edward P. Hutchinson, Instructor, Brookline Manual Training School, Brookline, Mass., would like to receive catalogs and other advertising literature on drawing instruments, drafting machines, machine tools, patternmaking and blacksmithing tools, foundry supplies.

Boring a Semi-circular Drill Jig

By W. L. Waterhouse

Details of a method of boring a semi-circular drill jig on the boring machine giving rapid and accurate results.

Fig. 1 shows a large semi-circular drill jig. The extension pieces *A A'* are for locating the jig relative to holes bored in the component in a previous operation. Where tapping holes are required to be drilled, slip bushes are provided as shown in the sectional view. In use the jig is secured to the work by large C-clamps and the whole mounted on an indexing fixture.

The keys *B B'* are for locating the jig longitudinally and fit into grooves cut on the outside of the component. Tapped holes and eye bolts (not shown) are provided for lifting the jig.

Fig. 2 is a plan view of the jig set up for boring the drill bush holes and also the holes for keys *B B'*, the work being done on a Lucas horizontal boring machine.

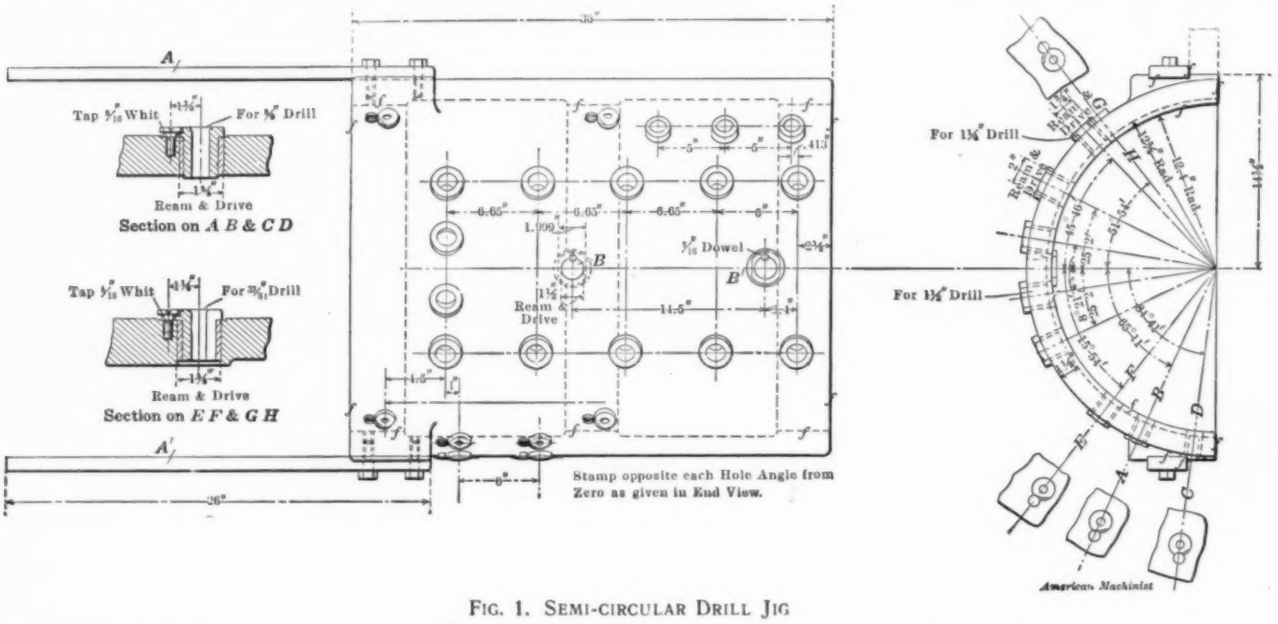

Tap 5/16" Whit
For 5/8" Drill
Ream & Drive
Section on A B & C D
Tap 5/16" Whit
For 33/64" Drill
Ream & Drive
Section on E F & G H
Stamp opposite each Hole Angle from Zero as given in End View.
For 1¼" Drill
For 1¼" Drill
American Machinist

FIG. 1. SEMI-CIRCULAR DRILL JIG

A is a plate with a locating boss, secured to a circular table and fixed in a central position by means of a plug fitting the hole in the center of the table and the plate, and having a reduced diameter at the end for the purpose of lining the table up with the machine spindle.

The method of doing this is clearly shown. Plug *B* is fitted to the machine spindle, the diameter, one inch, being the same as the reduced diameter of the plug fitted to the center of the table and plate *A*, and also the same as hole *a* bored in plate *C*.

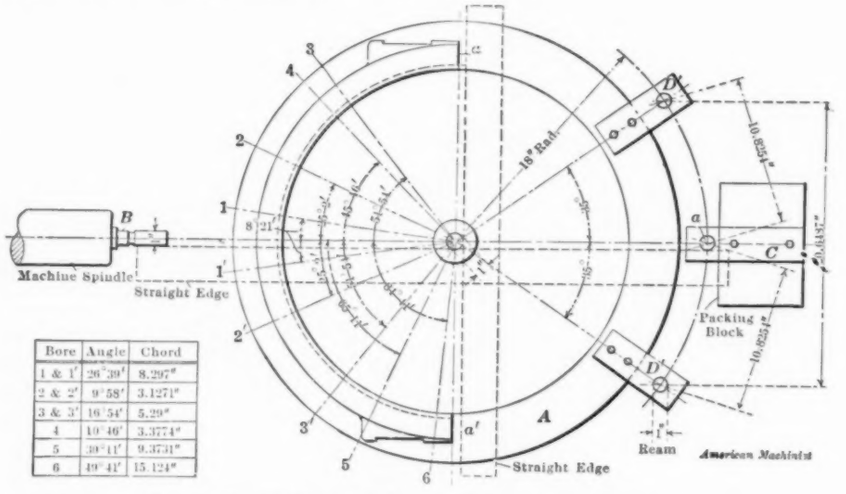
A straight-edge is clamped to the top of plate *A* parallel to the machine spindle. Plug *B* is then placed in the machine spindle and the machine table moved over until the straight-edge touches plug *B*. A 1-inch plug gage is then put into hole *a* in plate *C* and *C* located in the position shown.

The method of setting the jig at right angles to the machine spindle will be understood from the sketch. A 0.5-inch block gage is used between faces *a a'* of the jig and the straight-edge.

Pieces *D D'* with 1-inch reamed holes at the end are secured to plate *A* in the positions illustrated. It will be seen that the accuracy of the jig depends on these pieces being correctly located to the dimensions given.

After boring the holes for keys *B B'* with the jig set in the position shown, the circular table is rotated for boring holes 1 and 1'. One-inch standard plug gages are inserted in holes in *D* and *C* for boring hole 1, and in *D'* and *C* for boring hole 1'; the distance between centers of the plug gages are given in the list. The same method is followed in boring the rows of holes marked 2 and 2'.

In boring holes 3 and 3', 4, 5 and 6, pieces *D* and *D'* are rotated beyond the zero line an amount equal to the angle given from zero minus 35 degrees. The chords for the resulting angles are given in the table on the drawing. Plate *C* is placed so that *D* and *D'* will clear when rotated. The vertical distances are obtained in the usual way with hight gage and vernier.



Bore	Angle	Chord
1 & 1'	26°39'	8.297"
2 & 2'	9°58'	3.1271"
3 & 3'	16°54'	5.29"
4	10°46'	3.3774"
5	30°41'	9.3731"
6	49°41'	15.124"

FIG. 2. PLAN VIEW OF JIG IN POSITION FOR BORING

Increasing Shop Capacities

Metal Working

NEW ENGLAND

The Clark Bros. Bolt Company, Milldale, Conn., will erect a new factory.

The Weir Stove Company, Taunton, Mass., is building additions to its foundry.

The Narragansett Machine Company, Pawtucket, R. I., is building an addition.

MIDDLE STATES

Bennett & Buck, Freehold, N. J., will build a new garage.

The Krit Motor Car Company, Detroit, Mich., will enlarge its plant.

The Chapman Steel Company, Indianapolis, Ind., will erect a new factory.

The American Can Company, Cleveland, Ohio, will erect a five-story addition.

The Ford Motor Car Company will build a new factory at Long Island City, N. Y.

The Orrville (Ohio) Pump and Furnace Company will erect a new machine shop.

The Robinson (Ill.) Boiler and Manufacturing Company will move to Tulsa, Okla.

The plant of the Chatfield Brass and Iron Works, at Escanaba, Mich, will be enlarged.

The Harvey Spring Company, Racine, Wis., is having plans prepared for a new factory.

The United States Cartridge Company is constructing a new plant at Perth Amboy, N. J.

The Hamburg (Penn.) Boiler Works will erect an addition to be used as a flanging shop.

The Coughlin Pipe Wrench Company, Chicago, Ill., has taken out a permit for a new factory.

The shops of the Copper Range Railroad, at Calumet, Mich., were burned. Loss, $10,000.

The Cadillac Motor Car Company, Detroit, Mich., is looking for a suitable location for a plant.

The Crouse-Hinds Electric Company, Syracuse, N. Y., have had plans prepared for a new plant.

The Atlantic Coast Railway Company, Allenhurst, N. J., will build new car barns and paint shop.

The Crucible Steel Company of America will build a large addition to its plant at Harrison, N. J.

The "Soo" Line roundhouse, at Ashland, Wis., will be torn down and a new 24-stall roundhouse erected.

The F. A. L. Motor Car Company, Chicago, Ill., is seeking a location in the Central West for its main factory.

It is reported the Pungs Finch Automobile Company, Detroit, Mich., is considering the removal of its plant.

The building occupied by the Union Auto Garage Company, Akron, Ohio, was destroyed by fire. Loss, $50,000.

The Automatic Platen Press Company, of 346 Broadway, New York, will locate a factory at North Tonowanda, N. Y.

The Ayres Engine and Motor Company, a new concern, have had plans prepared for the erection of a plant in Trenton, Mich.

News items for the sales department—where more equipment will be needed. Authentic news is solicited for this department, not rumors or gossip—facts.

S. W. Scholey, of Tunkhannock, Penn., designer and manufacturer o fthe "Scholey Six" is seeking a location for an automobile factory.

The Columbia Planter Company, Springfield, Ohio, has secured site on which a new plant for the manufacture of grain planters will be erected.

The John A. Keim Company, Buffalo, N. Y., manufacturing pressed-steel products, will enlarge its factory at Kensington avenue and Liberty street.

The McRae & Roberts Company, Detroit, Mich., has had plans completed for a new plant to consist of foundry, finishing shop and power plant.

The plant of Bishop & Babcock, Indianapolis, Ind., manufacturers of soda fountains and refrigerators at Indianapolis, Ind., was burned. Loss, $200,000.

The Toledo (Ohio) Machine and Tool Company, manufacturing presses, dies, punches, shears, etc., is having plans prepared for additional buildings.

The Field Manufacturing Company, Bloomington, Ind., has been organized with $20,000 capital to manufacture cans. Incorporators, Leonard S., Frank M. and L. C. Field, etc.

The Elmira Tool and Supply Company, Elmira, N. Y., has been incorporated to manufacture machines, tools, etc. Capital, $30,000. Incorporators, John M. McDowell, Henry E. Van Ness, etc.

C. R. Teaboldt & Co., New York, have incorporated to manufacture and deal in motors, engines, machinery, etc. Capital, $50,000. Incorporators, E. Brooks, C. R. Teaboldt, G. F. Aitken.

Young Safety Razor Company, Atlantic City, N. J., has been organized with $100,000 to manufacture safety razors. Incorporators, E. I. Young, C. V. O'Donnell, Philadelphia; J. C. Farr, Atlantic City.

The Baltimore & Ohio Railroad will improve and enlarge its Mount Clare shop, at Pratt and Poppleton streets. New machinery will be installed in the iron-molding department and construction works.

The McKim Foundry and Machine Company, Lockport, N. Y., has been incorporated to operate a foundry and machine shop. Capital, $25,000. Incorporators, Daniel G. McKim, Harry M. Wood, L. J. Hooker.

The Auto Supply Manufacturing Company, Cleveland, Ohio, has been incorporated with $10,000 capital to manufacture automobile supplies and accessories. Incorporators, B. L. Wilson, Jas. F. Wilson, O. P. McGrath, etc.

The Great Lake Engineering Works, of Detroit, Mich., is about to ask for bids on a new $1,000,000 plant at Ashtabula, Ohio. The plans call for machine shop, blacksmith shop, joiner shop, power house, dry docks, etc.

Fire in the building at 102 Murray street, Newark, N. J., occupied by jewelry manufacturers, practically destroyed the equipment of the following concerns: Shiman-Miller Company, Eastwood-Park Company, Eckford & Ackley Company.

The Automatic Register Company, of Dover, Del., which recently purchased all stock and other assets of the American Fare Register Company, of St. Louis, is reported to have plans under way for the erection of a $500,000 plant in East St. Louis.

The Merit Motor Car Manufacturing Company, New York, has been incorporated to manufacture motors, engines, automobiles, etc. Capital, $30,000. Incorporators, Edw. B. Knight, 502 West One Hundred and Forty-fifth street; Edward C. Billings, 436 Fourth avenue, etc.

SOUTHERN STATES

The Southern Railway has commenced erection of repair-shop building at Charlotte, N. C.

The F. W. Poe Manufacturing Company, Greenville, S. C., will erect a machine shop at its plant.

The Grinnell (La.) Manufacturing Company, building power hammers, is considering the removal of its plant.

The McKinney Traction Cultivator Company, of Gainesville, Ga., will establish a plant. Is now having its machines built outside.

E. M. Beltz, of Pittsburg, Penn., a steel man, said to be representing big interests, has inspected site at Grafton, W. Va., for a plant. An open-hearth steel plant, structural-steel rolling mill and plate and bar mills are projected. The board of trade is interested.

By October 1, it is believed, plans will have been completed for the building of the new plant of the American Automobile Manufacing Company, at present located in the Lincoln building, Louisville, Ky. It is proposed to erect a factory to employ 250 men, with a capacity of a dozen cars a day, or an output valued at $2,000,000 a year. The company has a capital of $1,000,000. Berton B. Bales, president.

WEST OF THE MISSISSIPPI

A garage and modern machine shop will be erecte dat Ventura, Cal., by Milton Stiles. Size, 50x150 feet.

The Interstate Garage, Chicago, Ill., will erect a modern garage and machine shop at 2630-2632 Wabash avenue.

A concrete car barn to cost $200,000, will be erected at Los Angeles, Cal., by the Los Angeles Railway Company.

The Smith & Watson Iron Works, Portland, Ore., is building a new forge shop to be equipped with modern machinery.

The Missouri Pacific Railway, St. Louis, Mo., has issued a list of tools required on which prices are being received.

B. B. Bayliss, Chicago, Ill., is having plans prepared for a three-story garage and machine shop to be erected at 2243-2245 Wabash avenue.

The Ontario Hardware Company, Ontario, Cal., has purchased the property at B street and Euclid avenue in this city for $21,000. The present structure will be remodeled for its use.

The Bateman-Buoy Company, San Diego, Cal., will erect a two-story garage at Twenty-first and D streets, in that city. The rear portion of the main floor will be equipped as a machine and repair shop.

The Farmers Manufacturing Supply Company, Macedona, Tex., recently organized with $500,000 capital, has acquired site and is preparing to erect a plant to cost $250,000 for the manufacture of wire fencing, wire goods, cables, steel structural material and farm implements. Chas. Peterson and A. M. Avant, of San Antonio, are interested.

A $50,000,000 steel corporation is being formed in Los Angeles, Cal., by T. C. Middleton, J. C. Middleton and Robert Law. It will be closely allied to the United States Steel Corporation. The plant will be located in the vicinity of Los Angeles. Options have been made on iron-ore property in Riverside and San Diego counties.

CANADA

The Ivel Motor Company will build a large new factory at Winnipeg.

The Grand Trunk Pacific is building large new shops at Edison, Alberta.

The Winnipeg Steel Culvert Company will locate a large new factory at Winnipeg.

The Burrard Inlet Tunnel and Bridge Company will locate in North Vancouver, B. C.

The Kettle Valley Railway Company will establish large car shops at Penticton, B. C.

A. B. Jardine & Co., of Hespeler, manufacturers of taps and dies, are doubling their factory.

The Montreal Steel Works will spend $750,000 equipping a large branch plant at Longue Pointe, Quebec.

Fire destroyed $15,000 worth of machinery at the plant of the Midland Engine Works, at Midland, Ontario.

The John McDougall Caledonian Iron Works will locate a large plant in British Columbia at an early date.

The American Road Machinery Company, of Goderich, will go into the manufacture of automobiles and extend its plant.

The Canadian Railway Materials Company will locate large factory at Montreal for the manufacture of railway supplies.

T. McAvity & Sons, of St. John, New Brunswick, will locate one of the largest iron-working plants in Canada at Fort William.

The Halifax & Eastern Railway, head offices at Halifax, N. S., is under construction and much machinery and apparatus will be required.

General Manufacturing

NEW ENGLAND

Collyer & Keyworth, Gardner, Mass., will install a steam boiler.

The Geo. E. Belcher Company, Stoughton, Mass., will install a boiler.

The Phenix Lace Works is erecting a new factory at Riverpoint, R. I.

The C. A. Eaton Company, Brockton, Mass., will erect a seven-story shoe fatcory.

Fire destroyed the sawmill of G. W. Barker & Son, at Milford, Me. Loss, $60,000.

The Warren Woolen Company, Stafford Springs, Conn., will install a new waterwheel.

The C. C. Garrigas Machine Company, Bristol, Conn., will install boilers, engine and pumps.

Merriman Brothers, 696 East First street, South Boston, Mass., are in the market for a heavy band saw.

The city of Pittsfield, Mass., is considering the installation of a new pumping station and will use electric power pumps.

The Waypoyset Manufacturing Company, Pawtucket, R. I., making fine cotton goods, will erect an addition to its plant.

The United States Bobbin and Shuttle Company, Manchester, N. H., will erect an addition to its plant. Is in the market for boiler and engine.

The Rogers & Hubbard Company, Middletown, Conn., manufacturing granulated raw bone and fertilizers, has had plans prepared for a new building in Portland.

The Massachusetts Homeopathic Hospital, Boston, Mass., is contemplating the erection of an additional building in which a heating system and a new elevator will be installed.

MIDDLE STATES

Oakland, Ill., will install a waterworks system.

The Wyandotte (Mich.) Foundry Company is erecting a new plant.

Louis Kreich & Son will erect a boat-building plant at Appleton, Wis.

Peter Arinovitz is erecting a two-story machine shop at Marinette, Wis.

The Swissonia Knitting Mills, Allentown, Penn., is enlarging its plant.

The Chas. Boldt Glass Company, Cincinnati, Ohio, will erect a new factory.

L. O. Koven & Bros., Jersey City, N. J., will build a new power house.

N. T. Rich & Co., woolen goods, Cleveland, Ohio, will erect a new factory.

The town of Jamesburg (N. Y.) is going to build a new electric-light plant.

The Rensselaer (N. Y.) Water Company will enlarge its pumping station.

The Bertler Brick Company, Manitowoc, Wis., will install new machinery.

The Marlboro (N. Y.) Button Works is building an addition to its factory.

The Range Power Company, Chisholm, Minn., will install a steam plant.

Baker Bros., Toledo, Ohio, are erecting a new power house at their plant.

Swift & Co., Jersey City, N. J., will erect a $150,000 cold-storage warehouse.

The Buffalo (N. Y.) Brewing Company is enlarging its plant on Clinton street.

Gomery Brothers, Allentown, Penn., will erect a cold-storage and ice-making plant.

The Chapin-Sacks Ice Company, Washington, D. C., will erect additional buildings.

The Jos. Oshwald Brick Company, Cliffwood, N. J., will build a new power house.

John M. Vallinayer is erecting a large coal elevator on Hawthorne street, Toledo, Ohio.

The plant of the Hammond Paint Company, at Fishkill-on-the-Hudson, is being enlarged.

The Fostoria (Ohio) Aluminum Foundry Company will erect a plant in South Bend, Ind.

John I. Beggs, of Milwaukee, Wis., will erect an electric power house at Menasha, Wis.

The Lima (Ohio) Mattress Company has had plans prepared for an addition to its plant.

The Washington County Hospital, Hagerstown, Md., will install boiler, engine and pumps.

Fire destroyed the plant of the Van Nest Woodworking Company, Van Nest, N. Y. Loss, $50,000.

A five-story addition will be built to the plant of the Wabash Mills Company, Manayunk, Penn.

The Manchester Produce Company is erecting a new evaporating and vinegar plant at Sayre, Penn.

The Washburn-Crosby Company, Buffalo, N. Y., will erect another flour mill at 54 Michigan street.

The plant of the Bronx Sash Door Company, 100 Adams street, Bronx, New York, was destroyed by fire.

The plant of the Pittston Slate Company, at Slatington, Penn., was destroyed by fire. Loss, about $30,000.

The Tompkins Cove (N. Y.) Stone Company is spending $200,000 enlarging and improving its plant.

The American Type Founders Company, Jersey City, N. J., will build a two-story addition to cost $50,000.

Toledo, Ohio, is preparing to extend the city filtration paint. Additional pumps and engines will be installed.

Fire destroyed hoop factory, tie plug and stave mills of William Goldie & Co., Bay City, Mich. Loss, $15,000.

The Seeds Grain and Hay Company, Columbus, Ohio, whose elevator recently burned, is preparing to rebuild same.

The Arlington (Vt.) Refrierator Company is erecting several new buildings. Will need woodworking machinery and supplies.

The Diamond Clay Company, of Athens, Ohio, will locate a factory near East Clayton for the manufacture of brick.

The Philip-Carey Company, of Cincinnati, Ohio, manufacturing asbestos materials, etc., will locate a branch plant in Allentown, Penn.

The Hydraulic Power and Manufacturing Company, Niagara Falls, N. Y., contemplates making extensive additions to its power plant.

The Astoria (L. I.) Heat, Light and Power Company has taken out building permits for a new meter house, pump house and boiler house.

The Seitz Automobile Truck Company will erect a plant in Wyandotte, Mich., for the manufacture of heavy commercial auto trucks.

The F. N. Burt Company, Buffalo, N. Y., manufacturing paper boxes, will erect a $75,000 addition to its plant at 1464-1490 Niagara street.

The plant of the Rubber and Celluloid Harness Trimming Company, and the Rubberset Brush Company, Newark, N. J., was destroyed by fire. Loss, $200,000.

The Atlas Brick Company, Roseville, Ohio, has been incorporated to manufacture brick. Capital, $30,000. Incorporators, D. M. Moodie, David Moodie, J. William Drayton, etc.

The Arlington Cement Tile Company, Arlington, Ohio, has been incorporated by Wm. Rinehart, George Kimmell, George W. Myers and others, to manufacture tile and cement products.

The Franklin Woodenware Company, Columbus, Ohio, has been incorporated to manufacture woodenware. Capital, $10,000. Incorporators, C. H. Hughes, M. S. Browne, H. E. Thompson, etc.

The Toledo (Ohio) Webb Press Manufacturing Company has been incorporated to manufacture automatic printing machines. Capital, $30,000. Incorporators, Chas. F. Williams, J. G. MacKenzie, C. C. Chapman, etc.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open bids September 27 for 3200 pounds drawn rod brass, 1000 pounds drill rod steel, 54,000 pounds soft sheet steel (schedule 2898).

John Squires, consulting engineer, 863 Richmond avenue, Buffalo, N. Y., would like to hear from manufacturers of forgings, fittings, pressed-steel stampings, etc., to be used in the manufacture of a gasolene power truck.

The Verlus Company, Cleveland, Ohio, has been incorporated to manufacture electrical equipment, including storage batteries. Capital, $30,000. Incorporators, Harold H. Woods, George A. Waddle, Frank C. Wood, etc.

The Philips Manor Electric Light Company, Tarrytown, N Y., has been incorporated to manufacture and distribute electricity. Capital, $50,000. Incorporators, E. P. Benjamin, Tarrytown; D. Elder, Tompkinsville, S. I., etc.

The Van Kannel Revolving Door Company, Yardville, N. J., has been incorporated to manufacture revolving doors, windows, transoms, etc. Capital, $500,000 . Incorporators, T. Van Kannel, Yardville; L. W. Thompson, Yonkers, N Y., etc.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open bids October 4, for 30 testing generators, 10 electric heaters, inclosed arc lamps, ventilating sets, sockets and rings, etc. (schedule 2890), air compressor (schedule 2905).

The Crown Point Brush Company, Crown Point, N Y., has been incorporated to manufacture and deal in brushes, brooms, mirrors, etc. Capital, $50,000. Incorporators, John Morrison and John Morrison, Jr., of Troy, N. Y.; M. Judson Hickok and Robert Fish, Crown Point.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open bids September 27 for four direct-current motors (schedule 2901), brass pipe fittings, copper pipe (schedule 2896), brass and steel tubing (schedule 2899), brass tubing (schedule 2894), steel bolts and nuts, composition nuts (schedule 2896), brass machine and wood screws (schedule 2894).

SOUTHERN STATES

Arlington, Tenn., contemplates installation of waterworks system.

City of Maysville, Ky., will vote on issuance of $50,000 bonds for an electric-light plant.

The Henderson (N. C.) Power Company will rebuild an electric-light plant recently burned.

The city of Franklin, N. C., will vote on issuance of $24,000 bonds for waterworks system.

The city of Harlan, Ky., is having plans prepared for the construction of an electric-light plant.

The Odorless Refrigerator Company, Chattanooga, Tenn., has awarded contract for the erection of a $12,000 addition.

The Wauchula (Fla.) Manufacturing Company will double the capacity of its crate factory, install barrel factory, etc.

Bids will be received until September 29 for two 115-horsepower boilers, two steam driven air compressors, etc., by the United States engineer, at Wheeling, W. Va.

WEST OF THE MISSISSIPPI

Rippey, Iowa, has voted to issue waterworks bonds.

Harlowton, Mont., will install a waterworks system.

The Eldora (Iowa) Granite Works will erect a new building.

The Clinton (Iowa) Brewing Company will erect a bottling plant.

Alice, Texas, contemplates issuing $35,000 waterworks and street bonds.

A. J. Perkins flour and feed mill, at Medford, Wis., was destroyed by fire.

A pumping plant will be installed at the industrial school, at Benson, Ariz.

The St. Croix Gas Company has been granted a franchise at Hudson, Wis.

The W. H. Reickhoff Box Factory, at New Duluth, Minn., was destroyed by fire.

The Center (Tex.) Light and Ice Company will increase the capacity of its plant.

The Purity Ice Cream Company, Watertown, S. D., will erect a new factory.

A franchise will be granted J. B. Thompson, of Gilbert, Minn., to install an electric-light plant.

The lumber plant of the Acme Manufacturing Company, Tacoma, Wash., was burned. Loss, $35,000.

The Straight Electric Company, Des Moines, Iowa, is considering the erection of a plant at Dows, Iowa.

H. F. Pierce, of Bay City, Mich., has been granted a franchise to erect a lighting plant at Crosby, Minn.

A sewer system will be installed at Brawley, Cal., to cost about $18,000. Bids are now being asked.

The Santa Fe Consolidated Mines Company will erect a $20,000 mill a few miles from Cananea, Mexico.

The Fort Dodge Portland Cement Company plans the erection of a $2,000,000 mill at Gilmore City, Iowa.

Franchise has been granted Thos. D. Miller, of New Orleans, La., to install a gas plant at Cedar Rapids, Iowa.

The handle factory operated by Turner & Hirschmann, at Marked Tree, Ark., was burned. Loss, $50,000.

The Hospital for Children and Training School for Nurses, San Francisco, Cal., will erect a new boiler room.

The power house and electric-light plant of the Ruby Gulch Mining Company, at Zortman, Mont., were burned.

The Alhambra Laundry Company, Alhambra, Cal., have taken out a permit for the erection of a new building on Main street.

The city of Orange, Cal., has voted bonds for an outfall sewer to cost $16,000. The contract will be let by January 1.

A packing house will soon be commenced at Turlock, Cal., by the Erie Fruit Company. Modern equipment will be installed.

W. F. Turner and J. W. Barker have been granted a franchise by the town council, Atkins, Ark., for an electric-light plant.

Fire destroyed the plant of the Farmers Union Gin, at San Marcos, Tex. Loss, $12,000. It will be rebuilt on a larger scale.

The Mutual Orange Growers' Association, of Redlands, Cal., will erect a modern packing plant in this city to cost $28,000.

The Farmers Creamery and Produce Company will commence the erection of a creamery, boiler room and coal shed at Newell, Iowa.

The Bexhill Window Casement Company will erect a $25,000 factory at Los Angeles, Cal. The company manufactures a patented window.

The Imperial Valley Oil and Cotton Company are engaged in building an oil mill at El Centro, Imperial Valley, Cal. Modern machinery will be installed.

The Phillips Construction Company, of San Bernardino, Cal., will build a rock-crushing plant of 500 tons capacity at Porphry (near Corona), Cal., to cost $50,000.

A tract of land, at Normandie & Slauson avenues, Los Angeles, Cal., has been secured by Messrs. Lyster & Huebschen, of Chicago. A factory for building supplies will be erected.

The San Diego Shoe Company will build a factory at Coronado (near San Diego), Cal. The company is newly incorporated. F. A. Garretson, Ninth street, San Diego, is a director.

Plans are being made at Los Angeles, Cal., for intended improvements in the plant of the Precious Metals Mining and Manufacturing Company, at Goldfield, Nev., to cost $25,000.

The Commercial Club, of Marshalltown, Iowa, has signed a contract with F. L. Randall, of Boulder, Colo., to establish a factory for the manufacture of steel- and leather-tire protectors for automobiles. The firm will be known as the Central Tire Company.

CANADA

Strathroy, Ont., will install new waterworks machinery.

The Mendelssohn Piano Company will erect a factory at Toronto.

F. W. Henback will establish a large flax factory at Winnipeg.

New Liskeard, Ontario, is in the market for waterworks machinery.

The Montreal Hydro Electric Company will locate a factory at Montreal.

J. S. Ainslee & Bros.' stave mill, at Comber, Ont., was burned. Loss, $60,000.

The Modern Power Company will locate a large new factory at Winnipeg.

W. Stobbo, of Quebec, will equip a very large branch shoe factory in Montreal.

Orillia, Ont., will spend $30,000 for new electrical machinery for power purposes.

The Rochester Register Company, of Bridgeburg, will build large additions to its plant.

The British Columbia Electric Railway is extending its power plant at Vancouver, B. C.

The A. S. Carr Tent and Mattress Company, of Red Deer, Alberta, is extending its plant.

Ottawa, Ont., is in the market for large quantities of hydroelectric machinery and supplies.

The Winn Shoe Company, of Milton, Ont., will erect a $50,000 branch factory at Perth Ontario.

The Liverpool and Milton Tramway Company, of Nova Scotia, will buy large quantities of equipment.

Regina, Saskatchewan, will buy large quantities of electric machinery for extensions to its light and power plant.

The Asepto Soap Company, of St. John, New Brunswick, will install new machinery in a large addition to its plant.

Machinery valued at $30,000 destroyed by fire in J. D. Chenard's mill, at Berthier, Quebec, will be replaced at once.

The Canadian Coal Corporation, of Salmon Harbor, New Brunswick, will need a large amount of steam and electrical equipment.

The Canadian Pacific Lumber Company, capitalized at $5,000,000, will equip an immense mill at Alberni, British Columbia.

The plant of the Maybee Woodworking Company, of St. John, New Brunswick, destroyed by fire, will be replaced immediately.

The Western Canada Power Company, of New Westminster, B. C., is in the market for large quantities of electrical equipment of all kinds.

Another unit for the production of producer and water gas will be installed at the Intercolonial Railway shops, at Moncton, New Brunswick.

The Acadia Coal Company, of Stellarton, Nova Scotia, is in the market for large quantities of electrical machinery for driving and general lifting purposes.

W. P. McNeil & Co., of New Glasgow, Nova Scotia, are trebling their bridge-building plant and will buy large quantities of modern electrical machinery for lifting, etc.

The Nova Scotia Hydraulic Company, of which J. A. Clark, Halifax, N. S., is at the head, will be in the market for electrical supplies and equipment immediately.

A large new science building in connection with St. Francis Xavier College, at Antigonish, Nova Scotia, will be equipped with $50,000 worth of the most modern apparatus.

Business Item

The Frick Company, Waynesboro, Penn., has placed an order with Tate, Jones & Co., Inc., of Pittsburg, for a large plate-heating furnace, 8x10 feet inside. This will be equipped with the Kirkwood fuel oil-burning appliances.

Trade Catalogs

Ellery Twist Drill Company, Portsmouth, N. H. Catalog. Twist drills. Illustrated, 34 pages, 6x9 inches, paper.

The Toledo Electric Welder Company, Cincinnati, Ohio. Catalog. Electric welders. Illustrated, 36 pages, 6x9 inches, paper.

Norton Grinding Company, Worcester, Mass. Catalog No. 8. Plain machines for cylindrical grinding. Illustrated, 136 pages, 6x9 inches, paper.

The Electro-Dynamic Company, Bayonne, N. J. Circulars 36, 37 and 38. Interpole adjustable and constant-speed motors. Illustrated.

National Brake and Electric Company, Milwaukee, Wis. Publication No. 391. Air compressors. Illustrated, 68 pages, 6x9 inches, paper.

Baldwin Chain and Manufacturing Company, Worcester, Mass. Catalog No. 10. Transmission chains and sockets. Illustrated, 30 pages, 6x9 inches, paper.

Fay & Scott, Dexter, Me. Catalog No. 15. Standard engine lathes. Illustrated, 44 pages, 6x9 inches, paper. Catalog No. 16. Extension gap engine lathes. Illustrated, 28 pages, 6x9 inches, paper.

Forthcoming Meetings

International aviation meet, Belmont Park, Long Island, October 22 to 30. Auspices of the Aero Club of America, 29 West Thirty-ninth street, New York City.

National Machine Tool Builders' Association, annual meeting, October 25-26, Hotel Astor, New York. Chas. E. Hildreth, secretary, Worcester, Mass.

National Society for Promotion of Industrial Education, fourth annual convention, Boston, Mass., November 17, 18 and 19.

American Society of Mechanical Engineers; monthly meeting second Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's hotel. D. F. S. Clark, secretary, 141 Milk street, Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Tuesday each month. E. C. Bliss, president, 91 Sabine street, Providence, R. I.

New England Foundrymen's Association; regular meeting second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania; monthly meeting third Tuesday. Elmer K. Hiles, secretary, Fulton building, Pittsburg, Penn.

Superintendents' and Foremen's Club of Cleveland; monthly meeting third Saturday. Philip Frankel, secretary, 310 New England building, Cleveland, O.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. Secretary, J. H. Warder, 1735 Monadnock block, Chicago, Ill.

WANTS

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care, 505 Pearl street, New York, will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendations or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper catalog free. E.G.Smith, Columbia, Pa.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

The "Gas Saver" brazing forge; circular. J. L. Lucas & Son, 2 Fox St., Bridgeport, Ct.

Wanted—Work for screw machines and gear cutter. Box 775, AMERICAN MACHINIST.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Wanted—No. 1½ Pratt & Whitney hand miller, second hand. The Oster Mfg. Co., Cleveland, Ohio.

Light and medium weight machinery and duplicate parts built to order; tools, jigs, etc. MacCordy Mfg. Co., Amsterdam, N. Y.

Patents. C. L. Parker, Patent Attorney, ex-examiner Patent Office, 990 G St., Washington, D. C. Write for Inventor's Handbook.

Wanted—A machine for threading screw caps; want to get the most uptodate tool made. Send catalog and description to Box 968, AMERICAN MACHINIST.

Wanted—No. 2 Cincinnati or Milwaukee universal miller with all attachments; must be in A-1 condition and a bargain for spot cash. Robert Gair Company, Washington St., Brooklyn, N. Y.

Large English firm of machine tool importers having showrooms and offices in Great Britain, France, Germany, Italy, India and Japan is wanting good agencies for machine tools of all kinds. Box 189, AMER. MACH.

Wanted—A first-class foundry superintendent to take charge of small foundry in Massachusetts; must have $3000 or $4000 to invest and become part owner; this is a proposition for a high-grade man on jobbing work. Box 964, AMERICAN MACHINIST.

Established business in small tools already in wide and successful use requires additional capital to enlarge output and extend market; good opportunity on favorable terms for active or silent partner with $25,000 to $35,000. Box 956, AMER. MACHINIST.

Those breaks on power plant or machinery! Are you going to lose time awaiting new parts from makers, or will you let us weld them at one-fourth to three-eighths cost of replacements? Re-shipment within 24 hours. Oxy-acetylene process, producing homogeneous weld of cast iron. No charge unless successful. Waterbury Welding Works, Waterbury, Conn.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Wanted—An expert on boring mills and planers as working foreman; must be energetic and A-1 on drawings. Box 990, AM. M.

Wanted—Salesmen to handle on a generous commission basis, a well advertised and quick selling line of lathe tools; commissions given on all orders received from prescribed territory; send references with reply. Address "R. T.," AMERICAN MACHINIST.

Wanted—Salesman experienced in machinery or electrical lines to sell new line of portable electric tools on liberal commission basis; will allow definite territory to the man who will really work it; we know what can be done with this line and want a hustler to do it. Box 946, AMERICAN MACHINIST.

Wanted—For England in mills making brass and copper tubes, plates and rods, a competent overseer; a clever millwright with uptodate knowledge of methods of manufacture and capable of applying same, is the person required; state age, qualifications, previous situations and salary required. Care "Roller," P. O. Box 459, Hartford, Conn.

ILLINOIS

Wanted—Experienced general pattern-maker; also a machinist acquainted with electrical equipment. Fetzer & Co., Springfield, Ill.

Wanted—An assistant superintendent by growing manufacturer of sheet-metal goods. Town of 10,000; 180 miles from Chicago. Box 938, AMERICAN MACHINIST.

Wanted—Chief inspector; man with experience in modern system of inspecting machine parts; only man with large experience and modern methods considered. F. L. Reynolds, 218 West Superior St., Chicago.

Wanted—A thoroughly capable and experienced machine designer and draftsman; one who has had experience in building automatic machinery; give age, experience and salary expected in repuly. Box 966, AM. M.

Wanted—First-class man used to heat-treatment of nickel and other alloy steel; must be fully conversant with use of pyrometer; good position for right man. Answer, giving full experience. F. L. Reynolds, 218 West Superior St., Chicago, Ill.

MASSACHUSETTS

Wanted—High-grade designing draftsman with large experience in steam engineering practice for permanent position with a large manufacturing concern in Massachusetts. State age, education, experience and salary expected by addressing Chief Draftsman, Box 950, AMERICAN MACHINIST.

Wanted—Salesman experienced in machinery or electrical lines to sell new line of portable electric tools on liberal commission basis; will allot definite territory to the man who will really work it. We know what can be done with this line and want a hustler to to do it. Box 945, AMERICAN MACHINIST.

MICHIGAN

Wanted—At once, draftsman with at least two years' experience on gasolene engine and engine jig work; none but first-class man need apply. Box 917, AMERICAN MACHINIST.

NEBRASKA

Wanted—One machine room foreman; one expert cost accountant; one assembling department foreman, one with experience on automobile friction transmissions; all must be men with several years' experience in similar positions; men 35 to 45 years of age preferred. Box 963, AMERICAN MACHINIST.

NEW JERSEY

Wanted—Salesman familiar with the sale and manufacture of some good special line of machinery capable of profitable development for a modern plant. Address "Practical," AMERICAN MACHINIST.

Wanted—Mechanical engineer, familiar with some good line of machinery which could be taken up and developed by a well equipped foundry and machine shop. Address with particulars, "Reliable," AMERICAN MACHINIST.

NEW YORK

Wanted—Three good all-around machinists for general repair work. Apply Hatch Co., 91 Thompson St., New York.

Draftsman—Experienced on tools, jigs and fixtures. Apply Mergenthaler Linotype Company, 24 Ryerson St., Brooklyn.

Wanted—An all-around machinist, prefer an elderly man willing to work for moderate wages at light steady work. Give references and full particulars. Box 951, AM. MACH.

Wanted—Steam and board drop hammermen; state experience and where employed last; also a drop-forge foreman; must be A-1 man. Address reply to Superior Motor Vehicle Co., 1449 Niagara street, Buffalo, N. Y.

Wanted—Toolmakers, first class on model and special automatic machine work; good pay and steady work to competent men; give age, experience and reference; vicinity of New York City. Box 978, AMERICAN MACHINIST.

Foreman wanted for department using Gridley automatic, Potter & Johnston semi-automatics, Warner & Swasey hand screw machines; must be a hustler and good producer in quantity of high-grade work; applications strictly confidential. Box 960, AM. M.

Wanted—Steel stamp cutter; must be capable of doing any kind of work in that line and doing it well; no boozer; steady work to right man; state age, family, experience, wages wanted; if convenient, send samples of work. Address "Stamp Cutter," AM. MACH.

Wanted—Assistant superintendent wanted for automobile factory; must have practical knowledge of machinery, be a hustler and good producer in quantity of high-grade work; give full information as to experience, etc.; applications treated strictly confidential. Box 959, AMERICAN MACHINIST.

NORTH DAKOTA

Mechanical engineer and instructor to teach experimental engineering, kinematics as assist with machine design in state university; salary one hundred dollars for nine months; to insure reply send photograph, state age, nationality, condition of health, college degree and full statement of qualifications, also references. Address Calvin H. Crouch, Dean, Grand Forks, N. D.

OHIO

Melter wanted in a grey iron foundry melting twenty tons per day. Address Box 957, AMERICAN MACHINIST.

Wanted—Draftsman who has had experience on compressors and Corliss engines; state age and experience. The Heisler Co., St. Marys, O.

Wanted—Draftsman familiar with boiler-room practice, October 15; location northeastern Ohio; state age, qualifications and experience fully. Address Vulcan Furnace Company, Ellicott Square, Buffalo.

Wanted—Superintending foreman of machine shop, northeastern Ohio, October 15. State experience, qualifications fully, specifying age and compensation required. Address Vulcan Furnace Co., Ellicott Sq., Buffalo.

Wanted—First-class machinists, toolmakers die sinkers, lathe, planer, drill press, screw machine, boring and milling machine operators, wood patternmakers, brass molders, polishers, buffers, finishers, spinners, millwrights, hammermen and blacksmiths who are seeking positions or desirous of improving on those which they have, to register their names and addresses with the free Employment Department of the National Metal Trades Association. Address Commissioner's Office, 605 New England Bldg., Cleveland, O.

PENNSYLVANIA

Wanted—Floor hands and fitters on machine tool work. Colburn Machine Tool Co., Franklin, Penn.

Wanted—First-class foreman to take charge of assembling; must have had a satisfactory record as foreman; will pay $125 per month. Box 953, AMERICAN MACHINIST.

Wanted—Draftsman, with experience in designing horizontal double-acting ammonia compressors; state age, salary and experience. Box 969, AMERICAN MACHINIST.

Wanted—First-class man as inspector; one with some automobile experience preferred; first-class position for man who can come well recommended. Box 954, AMER. MACH.

Blacksmith foreman for Philadelphia plant; fully experienced and competent to take entire charge of 200 men and thoroughly familiar with heavy forging machines, steam drops, bulldozers, etc. Box 905, AM. MACH.

Wanted—Planer hands competent to produce maximum amount of work on medium and large planers; to such men we can offer steady employment, 60 hours per week; good wages; in answering state age and experience; location western Pennsylvania. Box 987, AMERICAN MACHINIST.

Wanted—First-class assistant superintendent in machine shops employing about 300 men; must have engineering ability and capable of producing economical results on jobbing work, as well as thoroughly understanding the operation of machine tools; address reply, stating age, experience, salary expected, etc. Box 967, AMERICAN MACHINIST.

The Monotype School is maintained to train young men to meet the constant demand for operators of our type casting and composing machine; these operators do so well that we receive more applications for places than can be filled; these qualifications carry most weight: Common sense, automatic machinery experience, printing office experience, type foundry experience. Full particulars will be furnished to inquirers who furnish the same information about themselves, and mention this paper. Lanston Monotype Machine Co., Philadelphia.

WISCONSIN

Wanted—Draftsman, bright young man to take charge of a small drafting room. Address "A. Z.," AMERICAN MACHINIST.

Foreman wanted for monitor department; must be strictly first class in every respect, none other need apply; steady work and good pay for the right man. Address Box 934, AMERICAN MACHINIST.

FOREIGN

The Commonwealth Government, Commonwealth Offices, 72 Victoria street, London S. W., invite applications for a manager of small arms factory, Lithgow, New South Wales, Australia. Age not to exceed 45. Testimonials, statement of service and qualifications for post required. Previous experience of manufacture of small arms essential. Candidates have to undergo medical examination. Salary £750. Applications to be addressed Secretary, Defence Department, Melbourne, Australia, to arrive not later than October 31.

SITUATIONS WANTED

Classification indicates present address of advertiser, nothing else.

COLORADO

Wanted—By man of wide practical experience in manufacturing, installing and repairing mining and power machinery; position with company who can appreciate results; experienced in handling men. Address "Practical," 329 Commonwealth Bldg., Denver, Colo.

ILLINOIS

Wanted—Position as general superintendent; have had a large experience designing and building gas engines. Box 925, AM. MA.

MASSACHUSETTS

Man, 34 years old, technical education, brought up through shop and drafting room to head draftsman, then superintendent in small plant manufacturing medium-size machinery, wants position with larger concern as assistant to superintendent or in production department. Box 986, AMERICAN MACHINIST.

NEBRASKA

Mechanical draftsman with 14 years' experience, wants position. Box 976, AM. MA.

NEW JERSEY

Draftsman, experienced on tool work, also shop experience, desires to change. Box 988, AMERICAN MACHINIST.

Draftsman, ten years' experience on automatic and special machines; A-1 man. Box 989, AMERICAN MACHINIST.

Energetic designer with patented machine, seeks reliable partner with capital, or established company who wish to make an addition. Box 983, AMERICAN MACHINIST.

Draftsman, mechanical, German technical school graduate, three years' shop and three years' drafting room experience, wishes position as detailer with automobile manufacturer; ambitious. Box 979, AMER. MACH.

Wanted—Position as draftsman by man experienced in the design, erection and operation of suction gas producers and gas engines; trade school graduate and International Correspondence Schools student; present salary $1080; age 23. Box 985, AM. MA.

Assistant superintendent or chief draftsman; accurate hustler; American; 37; seven years' shop and 15 years' office experience on keyboard and automatic machinery; excellent references. Box 272, Dumont, N. J.

Mechanical engineer, technical education, 22 years' experience in hydraulic, pneumatic and general engineering, shop work, etc., desires position as chief engineer or master mechanic. Box 962, AMERICAN MACHINIST.

First-class jig and tool designer, with 10 years' practical experience in various departments of well organized factories, desires position with company manufacturing motor boat engines or automobiles. Box 973, AM. M.

NEW YORK

Salesman, mechanical engineer, university graduate, five years' traveling experience, desires position. Box 955, AMER. MACH.

Advertiser, 35, desires executive position; preferably in patent-based industry; entirely competent. Box 965, AMER. MACHINIST.

Machine shop foreman looking for a position, up to date and a hustler; first-class references. Box 970, AMERICAN MACHINIST.

Designer, specialist on commercial trucks, will change position; $25 at start; New York preferred. "A Z," Post Office D, Brooklyn.

Draftsman with long experience in machinery and mill work, wishes position; New York or vicinity. Box 981, AMER. MACHINIST.

Mechanical superintendent of a large manufacturing plant, with twenty years' experience in general machine and foundry practice, desires making a change. Box 901, AMERICAN MACHINIST.

Mechanical engineer, technical graduate, ten years' experience on marine and general engineering, shops, construction and drafting room, desires progressive position. Box 984, AMERICAN MACHINIST.

Mechanical engineer, experienced in tools, operations, equipment and time setting, 12 years' experience in responsible manufacturing and commercial positions, desires change. Box 980, AMERICAN MACHINIST.

Foreman machinist, 15 years' all-around experience, first-class executive ability, energetic, thoroughly reliable, wishes position with prospects ahead; best of references given. Box 982, AMERICAN MACHINIST.

Brass and bronze foundry superintendent desires position; experience 16 years foreman, machinery, plumbers' supplies, chandelier, steam and water and art bronze; A-1 metal mixer. Box 971, AMER. MACHINIST.

Sheet metal superintendent and factory manager desires change; vicinity New York; expert in steel, brass and metal stampings every description; uptodate tools, dies and special devices for same; capable executive; fully competent. Box 974, AMER. MACHINIST.

Designer, graduate engineer, age 33, over 12 years' experience adding machines, typewriters, fine devices, medium and light automatic machinery, especially strong on experimental work and originating of new machinery, will consider change; location immaterial. Box 928, AMERICAN MACHINIST.

OHIO

Time setting and instruction card specialist solicits correspondence; can show remarkable record of increased production at reduced cost. Box 942, AMERICAN MACHINIST.

Foreman tool and diemaker or superintendent; a thorough expert on the design of all classes of the most uptodate methods of diemaking, tools, jigs, etc.; good organizer with executive ability in shop management; excellent references and recommendations. Box 975, AMERICAN MACHINIST.

PENNSYLVANIA

Mechanical engineer desires to change; experienced in developing ideas and devising means and methods of doing work systematically and cheap. Box 958, AMER. MACH.

Works manager or superintendent desires change; can show results in manufacturing either light or heavy work, as I am capable of bringing a factory strictly up to date without excuses. Box 961, AMER. MACHINIST.

Mechanic expert, 39; long experience as tool and die maker, foreman, designer of stampings to take place of castings, labor-saving devices for all purposes; automatic sheet metal and wire forming machinery; has inventive and cost figuring ability; knows how to handle help; best of references. Box 977, AMERICAN MACHINIST.

FOR SALE

For Sale—Lathe, drill, punch, forge, etc. Box 972, AMERICAN MACHINIST.

For Sale—Screw manufacturing business; excellent opportunity and profits; reasonable price; first-class machinery. Box 913, AM. M.

For Sale—Three return tubular boilers, manufactured by Riter Bros., Buffalo, N. Y. Drums 72x16 feet 0 inches; each boiler with sixty-six 4-inch tubes; inspected by Travelers Indemnity Company, of Hartford, Conn; 93 lb. steam pressure; boilers in good condition; can be delivered in two to three months, and seen in operation at Buffalo Bolt Company's plant, North Tonawanda, N. Y.

An opportunity to start a machine shop; we offer one of our departments for sale, the one used to establish our business; it is small and profitable work, but as we are devoting ourselves to heavier work, we offer to sell for $2000, all the drawings, patterns, and stock of finished and partly finished parts and rough material (inventories over $3000), circulars, electrotypes, special machinery and fixtures, and an established trade. Address Sipp Machine Company, Paterson, N. J.

Talks With Our Readers

By the Sales Manager

Do you realize how many manufacturers profit by our thoughtlessness or our indifference to getting what we know we ought to have?

This was brought forcefully to our attention a short while ago.

We called on a manufacturer and discussed advertising with him.

Pointed out the advantages of having as friends the live wires in the machine-making field—the readers of the AMERICAN MACHINIST.

Showed him what a tremendous force advertising was in creating good will.

Provided he had a tool that would back up his claims.

* * *

He listened attentively until we came to the important subject of copy.

We asked him if his tool would do as accurate and rapid work as a well known make advertised near this page. He was honest enough to say "No."

We asked him if it sold at a lower price.

He replied "No"—not to the user.

Then we asked him how he sold his tools in competition—what excuse he had for being in business.

He let out the secret.

* * *

He had an agent who represented a few advertised lines of tools.

Tools that were used as bait to catch the unwary buyer.

The agent talked the advertised tools—kept them in the foreground because the buyer had confidence in them.

Then, when they got the order for the entire shop equipment, they sandwiched in with a number of these good tools some of the nameless variety—on which there was more profit, but which would not stand the test of continuous advertising.

* * *

Many dealers appreciate the fact that it doesn't pay to do this now—more and more will when they know that their ultimate gain lies in having satisfied customers.

Yes, there are a few good tools that are not advertised. But remember poor tools can never be continuously advertised?

So, does it really pay to take chances when the best can be obtained without costing any more?

Buy advertised equipment—specify it in all of your orders—then you are safe.

* * *

Say you saw it in the American Machinist.

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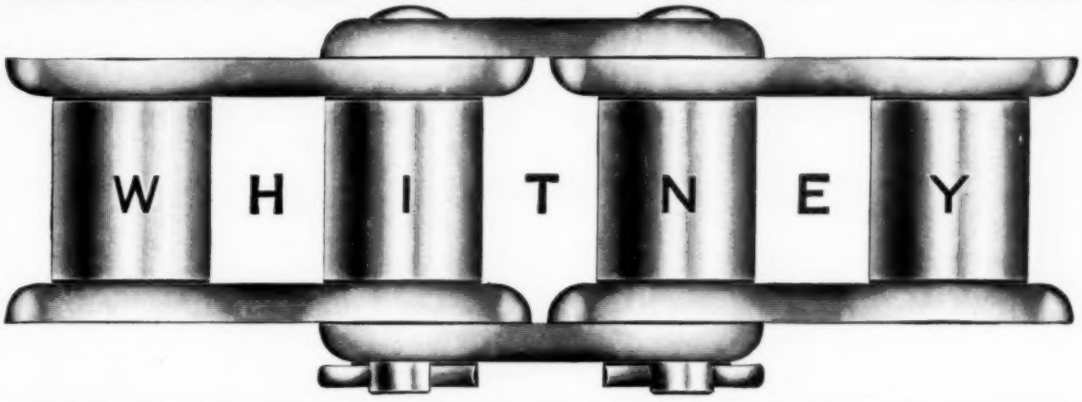
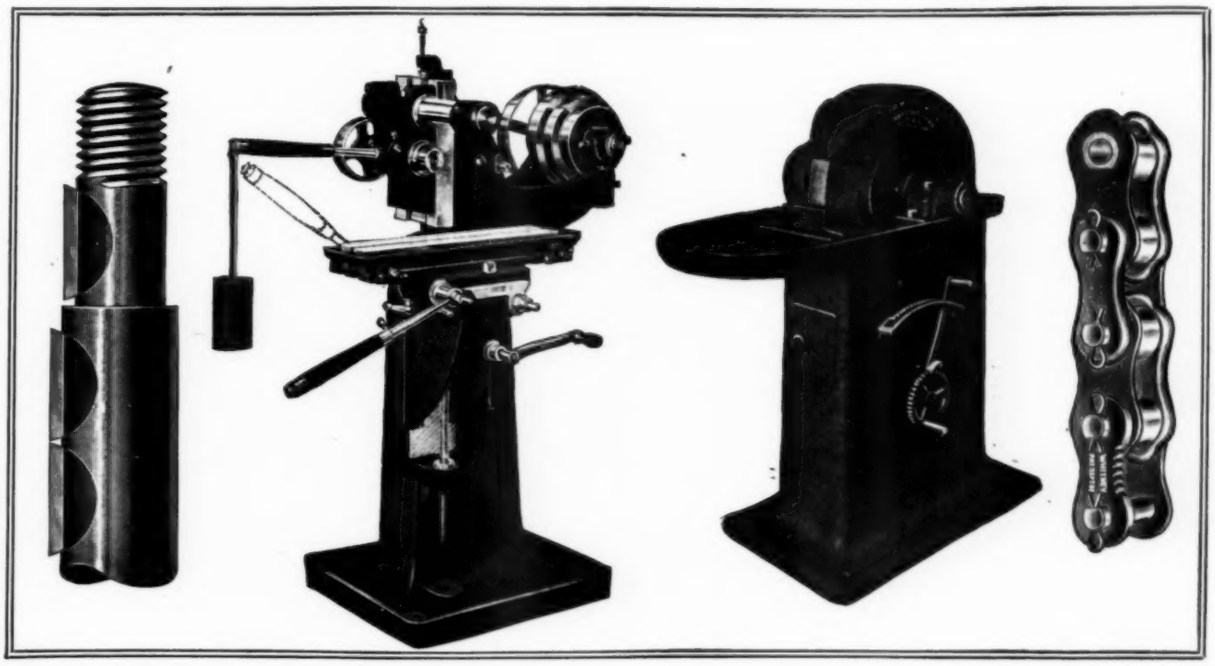


Chain Department

Roller Chains, Block Chains, Chain Belts, Quiet Chains, for Automobiles, Commercial Cars, Motorcycles, Bicycles, Machinery, etc.

Machine Department

Hand (feed) Milling Machines, 20-inch Water Tool Grinders, Keys and Cutters for the Woodruff Patent System of Keying, Presto Drill Chucks, Collets and Friction Tapping Devices.



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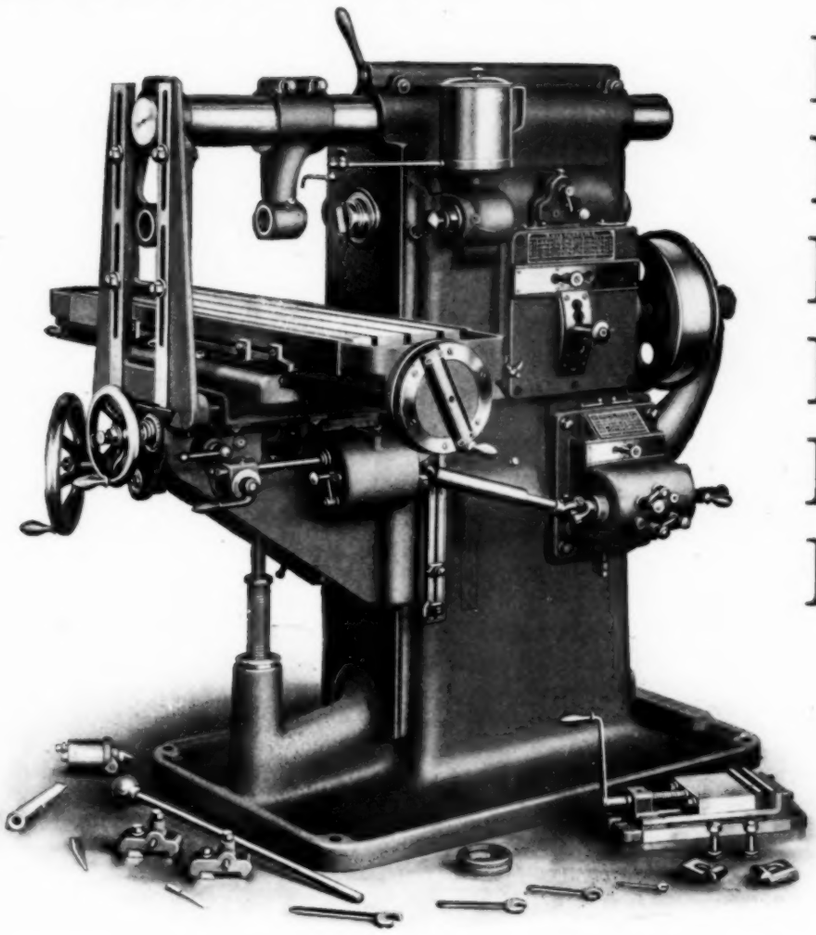
The heavy, rigid construction of the machine coupled with the high belt speed and large belt contact adapts it essentially for the heavier class of tool room work.



B. & S. No. 2 B Heavy Plain Milling Machine

With Constant Speed Drive

The base of the machine is exceptionally heavy and the metal distributed in such a way as to provide against any strains. The spindle, in particular, is housed by the heavy walls of the frame, thus doing away with all danger of any spring in the bearings.

A driving pulley of large diameter with an exceptionally wide belt, together with a pulley of the same size on the countershaft, gives high belt speed and large belt contact. The constant speed drive gives the machine the ability to pull heavy cuts.

Send for circular giving full description.

Brown & Sharpe Mfg. Co.

Providence, R. I., U. S. A.

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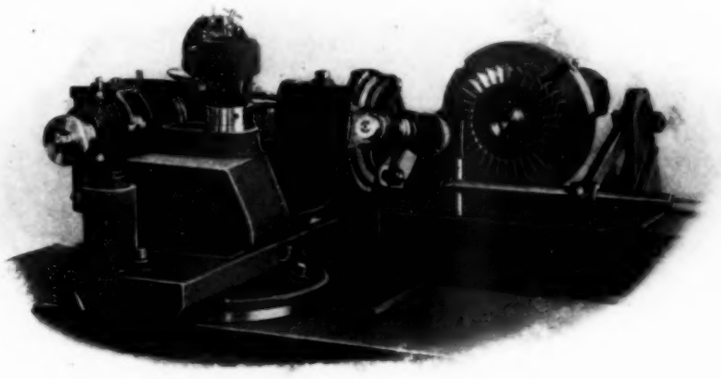

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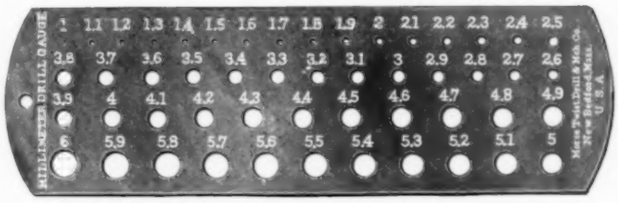

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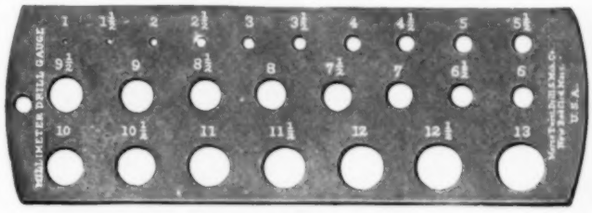

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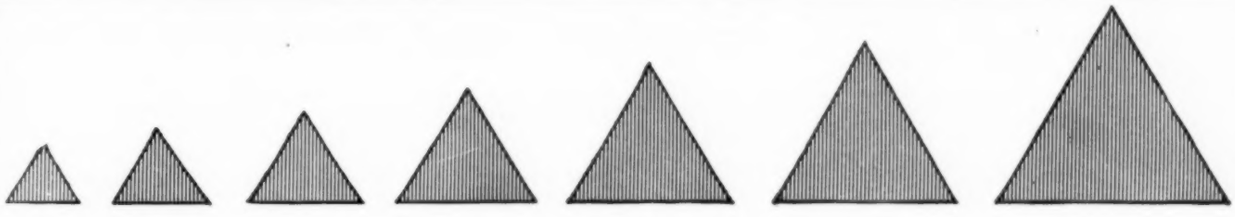

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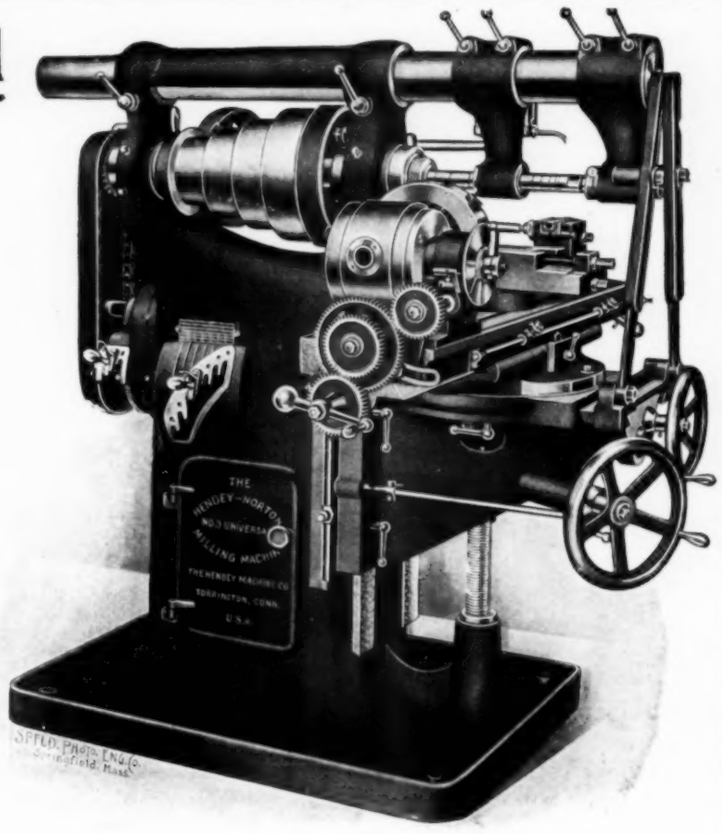

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Fully guaranteed.

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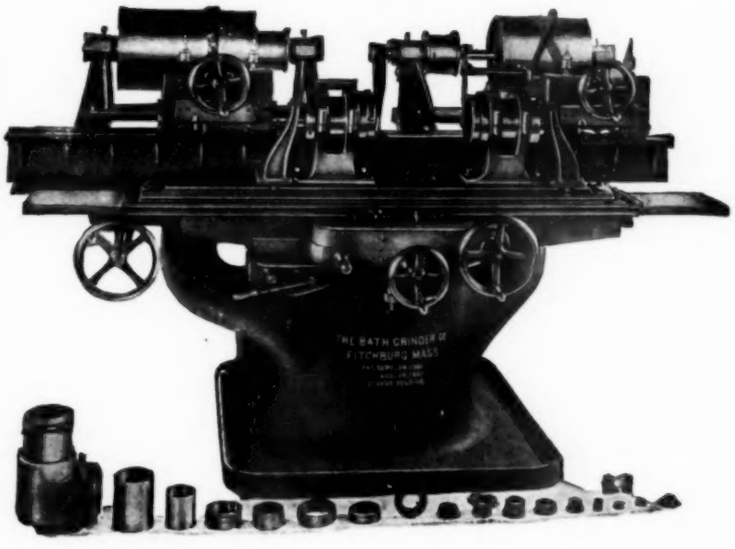

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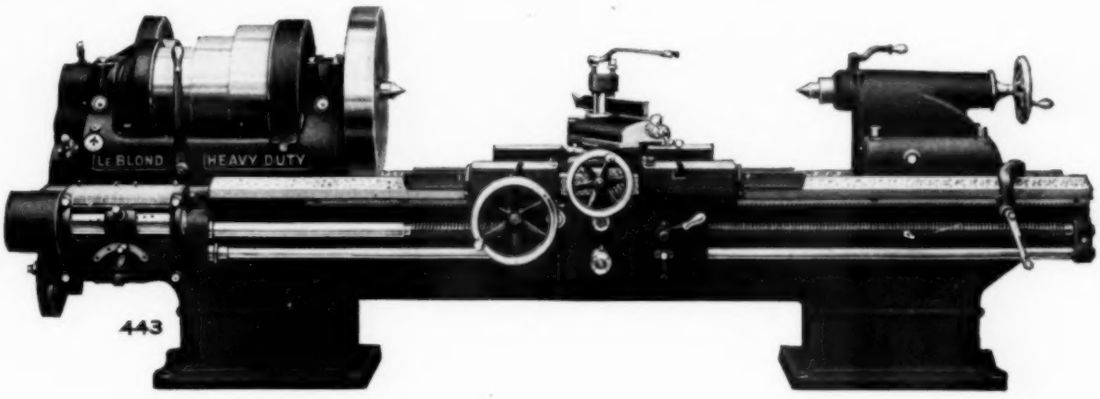

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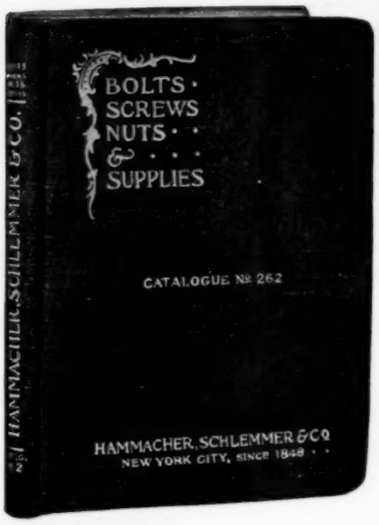

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